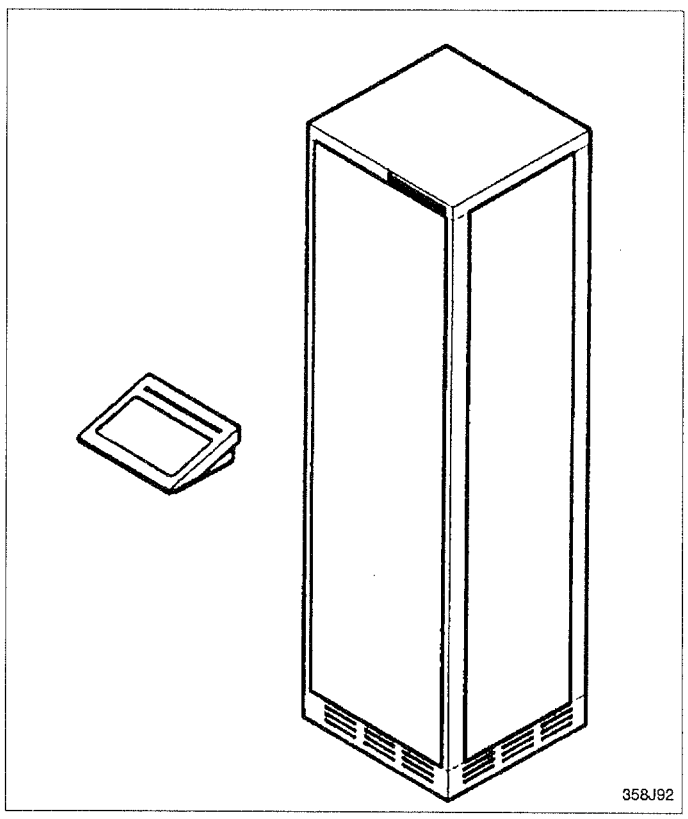
PHILIPS

Philips Medical Systems

SERVICE MANUAL
742
SUBSYSTEM

OPTIMUS 50/65/80

9890 000 02112	50 kW	– 1 tube
9890 000 02122	50 KW	– 2 tubes
9890 000 02132	65 kW	– 1 tube
9890 000 02142	65 kW	– 2 tubes
9890 000 02152	80 kW	– 2 tubes



CAN–controlled X–ray generator of the converter type

PMC Hamburg

Printed in Hamburg
Federal Republic of Germany
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Manual Order No. 4512 103 58273
OPTIMUS (b/95.0)
Reg_103_58273

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SERVICE MANUAL- SUBSYSTEM

Author: B. Freytag

OPTIMUS

Techn.No:

Type No: 9890 000 02112	50 kW - 1 tube	Basis	4512 104 70203
Type No: 9890 000 02122	50 kW - 2 tubes	Basis	4512 104 70203
Type No: 9890 000 02132	65 kW - 1 tube	Basis	4512 104 70602
Type No: 9890 000 02142	65 kW - 2 tubes	Basis	4512 104 70602
Type No: 9890 000 02152	80 kW - 2 tubes	Basis	4512 104 70602

Release: 1

In case there are any questions concerning this manual,
please send this LOPAD via fax to 49/(0)40/5078 2481

File: OPTIMUS 50/65/80_1_ 950E_INH
File: 4512 103 58273.b950

List of pages and drawings (LOPAD) **Manual Order No: 4512 103 58273**

1	(b/95.0)
3.1	(b/95 0)
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PRB-XRD products

Module code number:4512 982 00751

2- 0.1...0.2	**(b/95.0) E**	
2- 1...35	(b/95.0) E	
2Z- 1	(/94.1)	A3
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5Z- 1	(A/95.0)	A3
5Z- 2	(A/95.0)	A3
7- 0.1	**(/95.0) E**	
7- 1...2	(/95.0) E	
N- CL1	(/81.0)	
N- CL2	(/81.0)	
P- List		

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Z1- 1.1	(/95.0)	A3
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Z2-15.1	(/94.0)	A3

(nur für Fabrik Auslieferung)

Service software No: 4512 152 04754

XRG_SCOPE 1 (/94.1) E

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ADDITIONAL INFORMATION 11/95

1. Programming of the tube speed (chapter 9.3.4. Tube speed selection)

- The allowed tube speed for SRO tubes is 9000 rpm (only).
- The allowed range of tube speed for RO tubes is 3000 ... 3500 rpm in combination with a high speed rotor control.

Caution!
Wrong programming could destroy the rotor control unit.

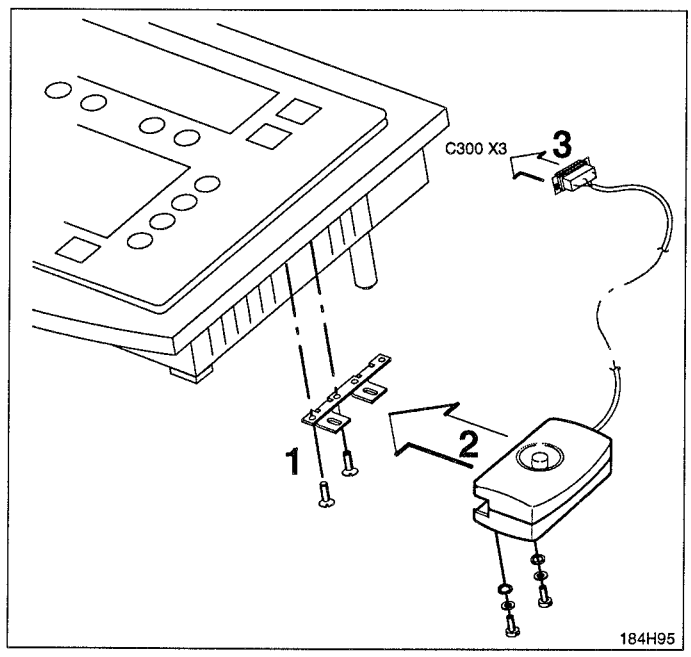
- For RO tubes in combination with low speed rotor control only 3000 rpm.

2. New handswitch

As of about November 1995 the control desks will be delivered with a different release switch. This switch can be fitted either to the right or left–hand side of the desk.

Fitting procedure:

- Using the two M4x10 countersink screws attach the holding bracket to the edge of the desk (1). For visual reasons the release button should be in line with the +/– buttons on the control desk so please use the appropriate holes in the bracket.
- Slip the release switch over the edge of the desk and fasten in position using the two M4x10 cheese–head screws, securing rings and washers (2).
- Connect the plug of the release switch to C300X3 on the rear of the desk (3).
- When fitting the desk cable cover make sure the cable strain relief device (1 cable tie) remains under the cover.



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3. Setting–to–work with bucky controller

– Tube data and APR files can only be successfully loaded if the CAN interface EZX43 is disconnected.

– Adaptation of the tubes is only possible if the signal bus is removed from EZX23.

– For the generator Ready state the bucky system also has to have minimum programming.

Based on these conditions, when setting–to–work a non–preassembled system it is advisable to proceed in the following sequence:

- From the unit, program the bucky controller. The minimum programming depends on the system:
  - System configuration (tomography, wall stand)
  - Table configuration (cassette sensing, bucky device type)
  - Ceiling suspension (tomo drivers, collimation type, longitudinal and transverse sensor)
  - Wall stand (wall stand type, cassette sensing, WS default height, bucky device type)
  - All adjustments
- Disconnect EZX23 and EZX43 from the generator.
- On the generator perform a programming procedure without reset in between:
  - Date and time
  - Mains data
  - Tubes
  - Dose rate control
  - Registration devices
- For trial operation also program "Free Cassette" on RGDV8:

Data Set A:	Tube	:	Tube 1
	Mounted release circuit	:	None
	Syncmaster present	:	No
	Dose measurement unit	:	None
	Multiple releases ...	:	Disable
	Mounted bucky controller	:	None

  (Prerequisite: at least Rel. 0.3 in the bucky controller; otherwise use RGDV 4.)
- Reset the generator.
- When Ready has appeared with the RGDV8 selected, perform a trial start. One should check beyond all doubt that the anode has actually started!
  Starting is definite if continued anode running can be heard clearly after acceleration.
- Make a test exposure.
- Reset the generator.
- Adapt the tube.
- Reset the generator.
- Program the generator as follows:
  - Language
  - Predefined Assignment (loading of APR files)
  - Deactivate RGDV8 if it is no longer required.
- Connect CAN and signal bus to EZX43 and EZX23.
- Reset the generator.
- Continue programming the bucky controller, e.g. APR assignment etc.

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LIST OF PAGES AND DRAWINGS

Module code number: 4512 982 00751

Author: B. Freytag
GSI22

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Z–3	(94.0)	A4
Z–5	(94.1)	A4
Z–7.1	(95.0)	A2/A3
Z–7.2	(95.0)	A2/A3
Z–7.3	(95.0)	A2/A3
Z–7.4	(94.0)	A2/A3
Z–20.1	(95.0)	A1/A3 (4512 982 00101)

OPTIMUS

PLANNING DATA

TEXT:

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Legend for earthing and cabling diagram Z–20.1

1. Product information

The OPTIMUS family of generators for radiography is based on computer–controlled converter technology.

The converter operates in the non–audible frequency range.

Applicational options are essentially achieved by releasing software modules using customized PAL ICs.

Control between the internal function units (FUs) and the external online equipment takes place via a CAN bus.

Safety–relevant signals are transferred directly on the so–called signal bus.

Units without any CAN interface are operated via the "Adapter decade cable" option.

1.1 Applications

- Radiography
- Tomography

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1.2 Options

– Mains transformer 400 ... 480 V, 50/60 Hz, also for 400 V mains supply without neutral lead N with taps for 400 / 440 / 460 / 480 V	9890 000 02301	
– Low–speed rotor control	9890 000 02201	
– High–speed rotor control	9890 000 02211	
– Automatic input of tomo times	9890 000 02221	
– Tomo density control	9890 000 02231	
– VARIO FOCUS	9890 000 02271	
– Adapter decade cable for 4 aux. units	9890 000 02311	
– Option rack	9890 000 02321	
– Adapter AMPLIMAT cable 3+/D–Sub	9890 000 02331	
– Operating panel	9890 000 02401	
– Stand for operating panel	9890 000 02441	
– Wall mounting of operating panel	9890 000 02451	
– Adaptation for 230 V release circuits	9890 000 02461	
– Decade cable set	9803 704 20102	
– Extension set for one additional tube	9803 709 20002	14 x 4 m, top decade → AMP decade
– Mains transformer 190 ... 390 V, 50/60 Hz with taps for 190 / 200 / 207 / 220 / 230 / 240 / 250 / 343 / 380 / 390 V	9803 720 81002	max. 50 kW!

2. Compatibility

2.1 Versions

. . . of the X–ray generator family OPTIMUS 30/50/65/80/100 9890 000 02001

– 50 kW generator for 1 tube:	OPTIMUS 50	9890 000 02111
– 50 kW generator for 2 tubes:	OPTIMUS 50	9890 000 02121
– 65 kW generator for 1 tube:	OPTIMUS 65	9890 000 02131
– 65 kW generator for 2 tubes:	OPTIMUS 65	9890 000 02141
– 80 kW generator for 2 tubes:	OPTIMUS 80	9890 000 02151

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2.2 Tubes

Recommended standard tubes:

RO 17 50
SRO 25 50
SRO 33 100

Further compatible tubes:

RO 12 30 SRO 20 50
RO 30 50 RE
SRO 13 30

Compatible tube housings:

ROT 350
ROT 351

Current information on further tubes to be connected is available at the service center Hamburg.

3. Mechanical data

Installation dimensions and weights: see drawing Z–1

Transport data:

	Weights (kg)		Dimensions (cm)		
	net	gross	length	width	height
Case 1: Contents: generator cabinet, operating panel	178	226	210	82	84
Case 2: 1–tube version 2–tube version Contents: H.V. generator	73 88	100 115	77	67	80

4. Environmental data

according to PMS standard UXW 13600

4.1 Climatic conditions

Ambient temperature: 10 ... 40 °C
Relative humidity: 15 ... 90 %, no condensation
Relative atmospheric pressure: 70 ... 110 kPa

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5. Electrical data

5.1 Power data and mains conditions

	50 kW	65 kW	80 kW
Power data:			
Mains voltage	3 × 400 V ±10%		
	3 × 400/440/460 V ±10% 3 × 480 V −10%, +6% } with internal transformer (option)		
	3 × 190...343 V ±10% with external transformer, max. 50 kW (option)		
Mains frequency	49 ... 61 Hz		
Max. mains current			
– at 400 V	145 A	190 A	230 A
– at 440 V	135 A	180 A	215 A
– at 460 V	125 A	170 A	210 A
– at 480 V	120 A	160 A	205 A
– at 190 V	300 A	–	–
Fuse protection (slow–blow)	35 A 100 A at ≤ 240 V	50 A	
Mains resistance			
– at 400 V	≤ 300 mΩ	≤ 200 mΩ	
– at 440/460 V	≤ 350 mΩ	≤ 240 mΩ	
– at 480 V	≤ 400 mΩ	≤ 300 mΩ	
Unit supply	230 V / 400 V, max. 5 A		
Max. output power	50 kW	65 kW	80 kW

5.2 Operating data

	50 kW	65 kW	80 kW
Tube current	10 ... 650 mA	10 ... 900 mA	10 ... 1100 mA
Tube voltage	40 ... 150 kV in 1 kV or % steps		
mAs product	0.5 ... 850 mAs		
Exposure time	1 ms ... 6/16 s		
Exposure sequency	≤ 12 exp./s		
Noise level	≤ 40 dBA		
Heat dissipation	500 W		

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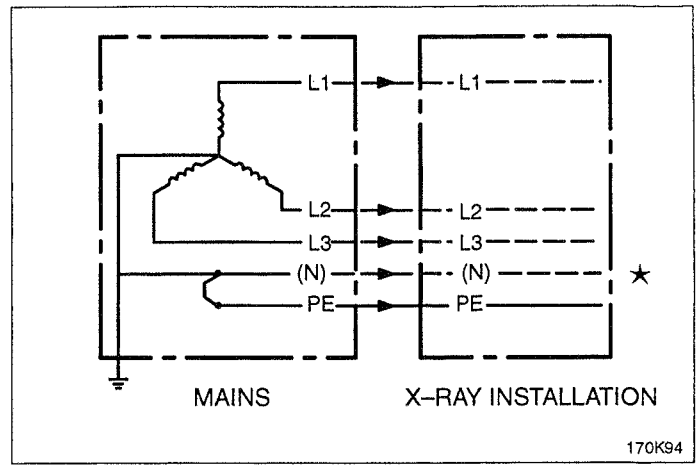
5.3 Power supply

5.3.1 Type of power supply



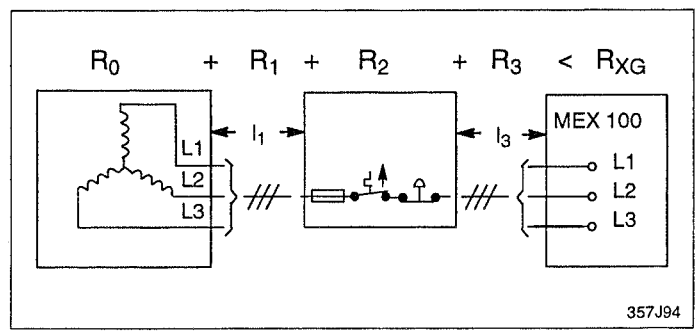
Standard connection:
- 3 phase wye
- 400 V
- Neutral, earthed (★ not required if the mains transformer 9890 000 02301 is ordered)
- Earth

Connection with the internal mains transformer 9890 000 02301 (option):
- 3 phase wye or delta
- 400 / 440 / 460 / 480 V
- Earth, balanced

Operation on three–phase mains that are unbalanced to earth (e.g. with one phase earthed) is impermissible unless adequate adaptation measures have been taken!

Check that the sequence of phases in the wall junction box is correct corresponding to the designations L1, L2, L3.

5.3.2 Calculating the mains resistances



If possible, the sum of R_0, R_1, R_2 and R_3 should be smaller than the R_{XG} required.

With higher internal mains resistances the generator output is reduced respectively.

Note that the cross section of lead l_3 must not exceed 25 mm^2.

- R_0 designates the mains resistance on the distributor transformer.
- R_1 is dependent upon the length of lead l_1 between distributor transformer and main distributor and upon the cross section selected, so:
  $R_1 = l_1 \times R_{Cu}$ R_{Cu} from table
- R_2 is estimated to be 15 mΩ
  - EMERGENCY–OFF switch 4 mΩ
  - Earth–leakage circuit breaker 5.5 mΩ
  - Fuse 5.5 mΩ

  } 15 mΩ
- R_3 is dependent upon the length of lead l_3 between main distributor and wall junction box and upon the cross section selected, so:
  $R_3 = l_3 \times R_{Cu}$ R_{Cu} from table

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The resistances already consider the go and return line so that the calculation can be based on simple cable lengths.

Copper cross section [mm^2]	Resistance R_{Cu} [in mΩ/m]
16	2.19
25	1.4
35	1.0
50	0.7
70	0.5
95	0.38
120	0.30
150	0.24

5.3.3 Earth–leakage circuit breaker

To be provided between fuse and X–ray installation depending upon local regulations.

Siemens earth–leakage circuit breaker:

Order No. 5SM1 3466

Rated fault current 30 mA

Rated current 63 A

Connection terminals for wire cross sections of up to 25 mm^2.

5.3.4 EMERGENCY–OFF device

To be provided depending upon local regulations.

There are 2 possibilities:

1. All the EMERGENCY–OFF buttons are connected in series and looped into the switch on circuit (12 V DC) of the generator.
2. The EMERGENCY–OFF circuit acts on an external main contactor which switches off the power before it is fed into the generator.

6. Tools

In addition to the standard tools the following are required:

- Service–PC
  IBM– compatible, 640 kB RAM, 3.5" floppy disk drive, ≥ 1 serial port
- 0–modem cable; recommended length = distance generator cabinet – operating desk
  Male 9–pole D–Sub connector at the generator end.
- Installation and service software 4512 152 04754 supplied on a floppy disk with the generator.
- PC–Hardkey (DIAGGEN) to use the installation and service software.
- Mains resistance measuring instrument.

7. Traceable items

- X–ray control (generator cabinet, operating panel)
- H.V. generator

The items are assigned the same series number when delivered ex factory.

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8. Preparation

Connection of the generator:	see drawing Z–3
Operating panel:	see drawing Z–5
Connection diagram:	see drawing Z–7.1/2/3
Earthing diagram:	see drawing Z–7.4
Legend:	see drawing Z–7.5

8.1 Installation materials

To be ordered from the service department via PMS Hamburg:

– Wall junction box 4512 103 75384
inclusive connection block (25 mm^2) for mains supply and connection block (10 mm^2) for unit supply.

8.2 Cables

– **H.V. cables** 9806 402 6xx02

plugs:	O3/O3
length:	6 ... 20 m in steps of 2 m
capacity:	155 pF/m
diameter:	16.5 mm

The cable length is indicated at the 9th and 10th digits of the code No.

– **Thermal contact cable**

2–wire screened for 1 excess temperature switch	4512 100 66151
10–wire screened for additional supervision like temperature alarm switch, buzzer, selection indicator.	0722 215 19005

– **Stator cable** 3 × 1.31 mm^2, screened 0722 215 02054

– **AMPLIMAT cable** with 3 PLUS plugs

8...28 m	9803 507 0xx02

The cable length is indicated at the 9th and 10th digits of the code No.
AMPLIMAT cables with 3PLUS plugs can be connected in the generator via the following adapter for each cable.
Adapter for measuring chamber cable 9800 000 02331
(contained in the accessories; 2 items for 1–tube–version, 3 items for 2–tube–version)
or

– **AMPLIMAT cable** with D–Sub and 3 PLUS plug. Only suitable for ALC–measuring chambers.

12 m	9890 000 01721
16 m	9890 000 01731
20 m	9890 000 01741
24 m	9890 000 01751

– **Operating desk cable set**

10 m	9890 000 02411
20 m	9890 000 02421
30 m	9890 000 02431

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8.3 Manpower

At least two persons to insert the H.V. generator, which weights about 110 kg, in the generator cabinet.

9. Planned maintenance

The technical documentation for carrying out maintenance work in compliance with the applicable regulations are available at the responsible authority of Philips Medical Systems.

The importance of having maintenance implemented is pointed out to the operator in the operating instructions.

It must be guaranteed that the person carrying out maintenance work knows about the respective national regulations and that this person observes these regulations throughout all steps of maintenance work.

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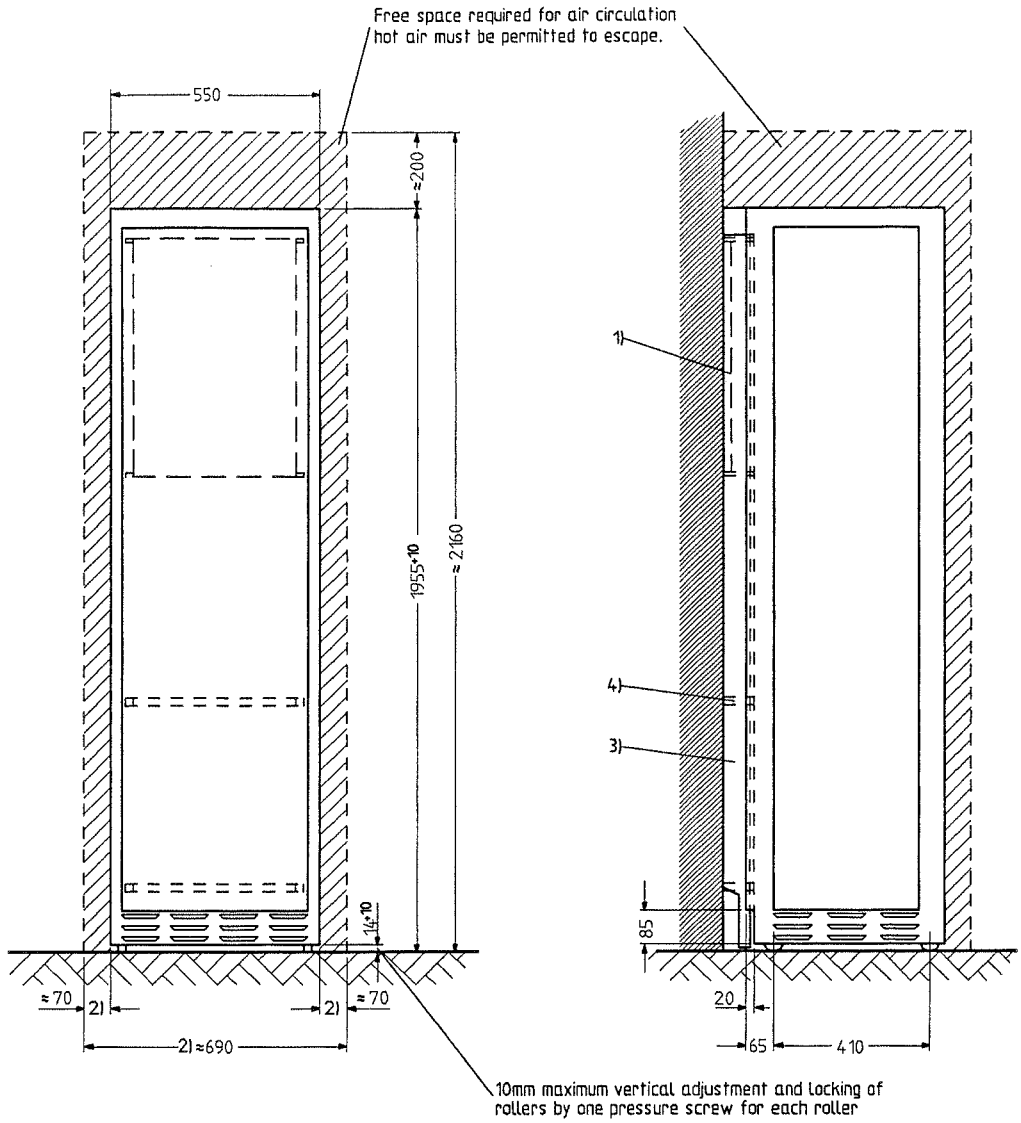

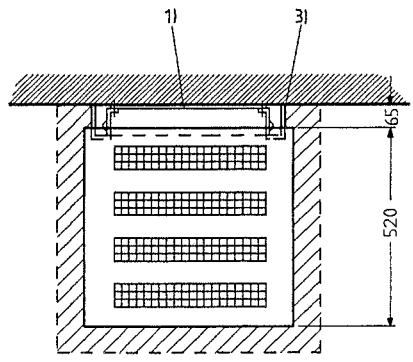

1) Wall junction box

2) Lateral clearance unless there is an adjacent cabinet

3) Filler panel

4) Wall-cabinet spacing angle

weight : 210 kg

A2/A4 94-09-22 Schr
u00614

Dimensions and weight

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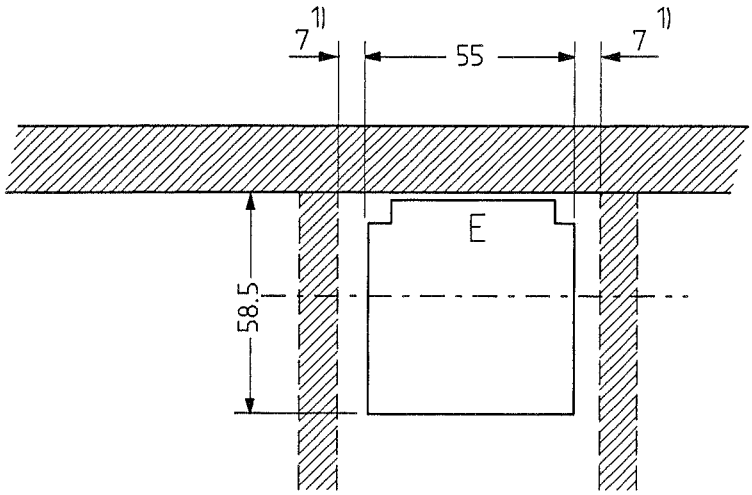
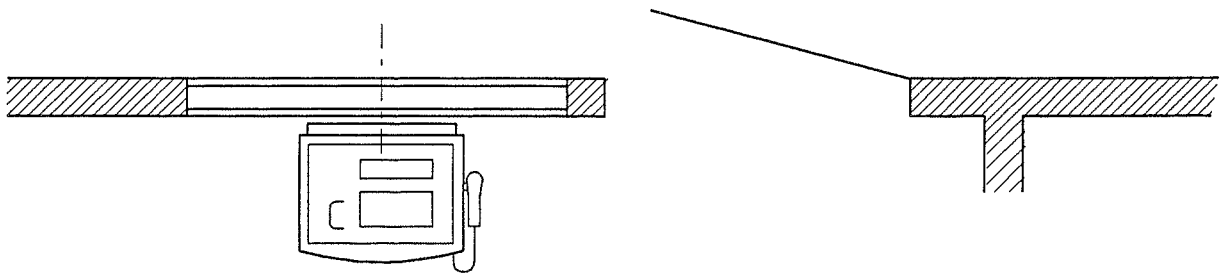


1) With no other cabinets beside them

E= Control cabinet

C= Operating desk



scale 1:20 measures in cm

PRB-XRD products

A4 94-09-21 Schr.
u00670

Overlayer for room layout

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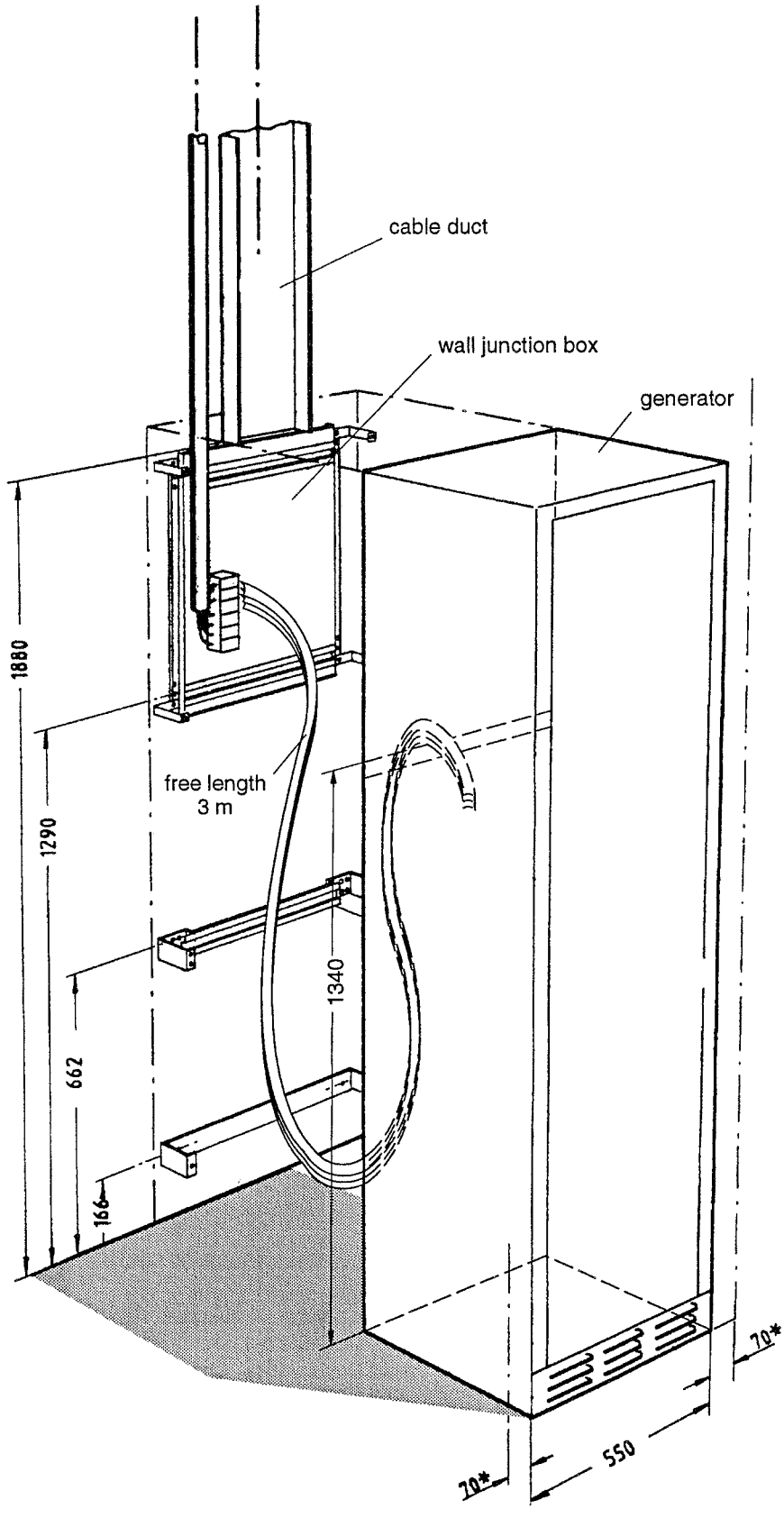

*) Space with no other cabinets beside them.

Connection of generator

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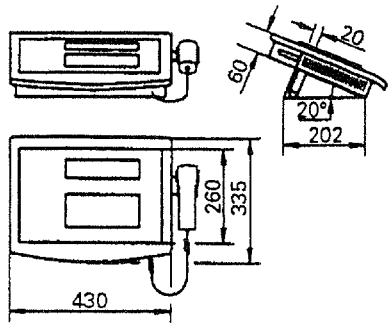
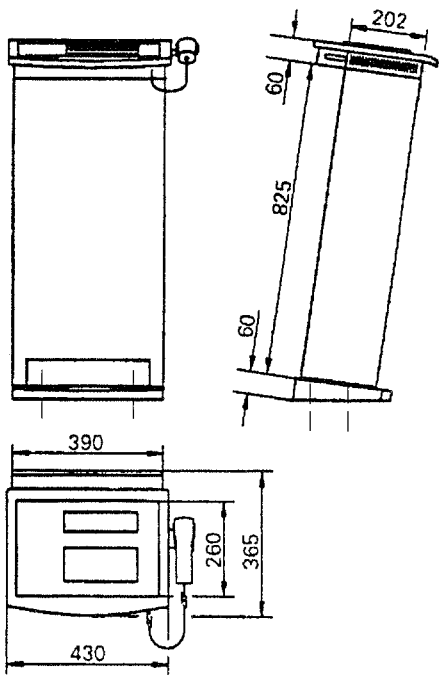
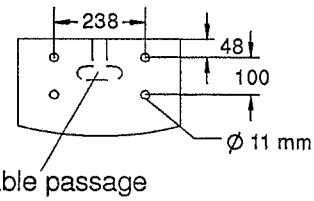
① Low profile control desk



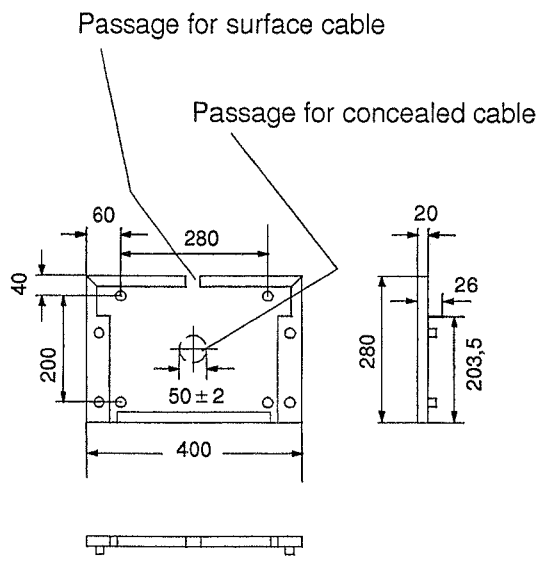
② Stand for low profile control desks



mounting drillings in the bottom of the stand



③ Wall-mounting support



Weight ≈ 2kg

Operating panel

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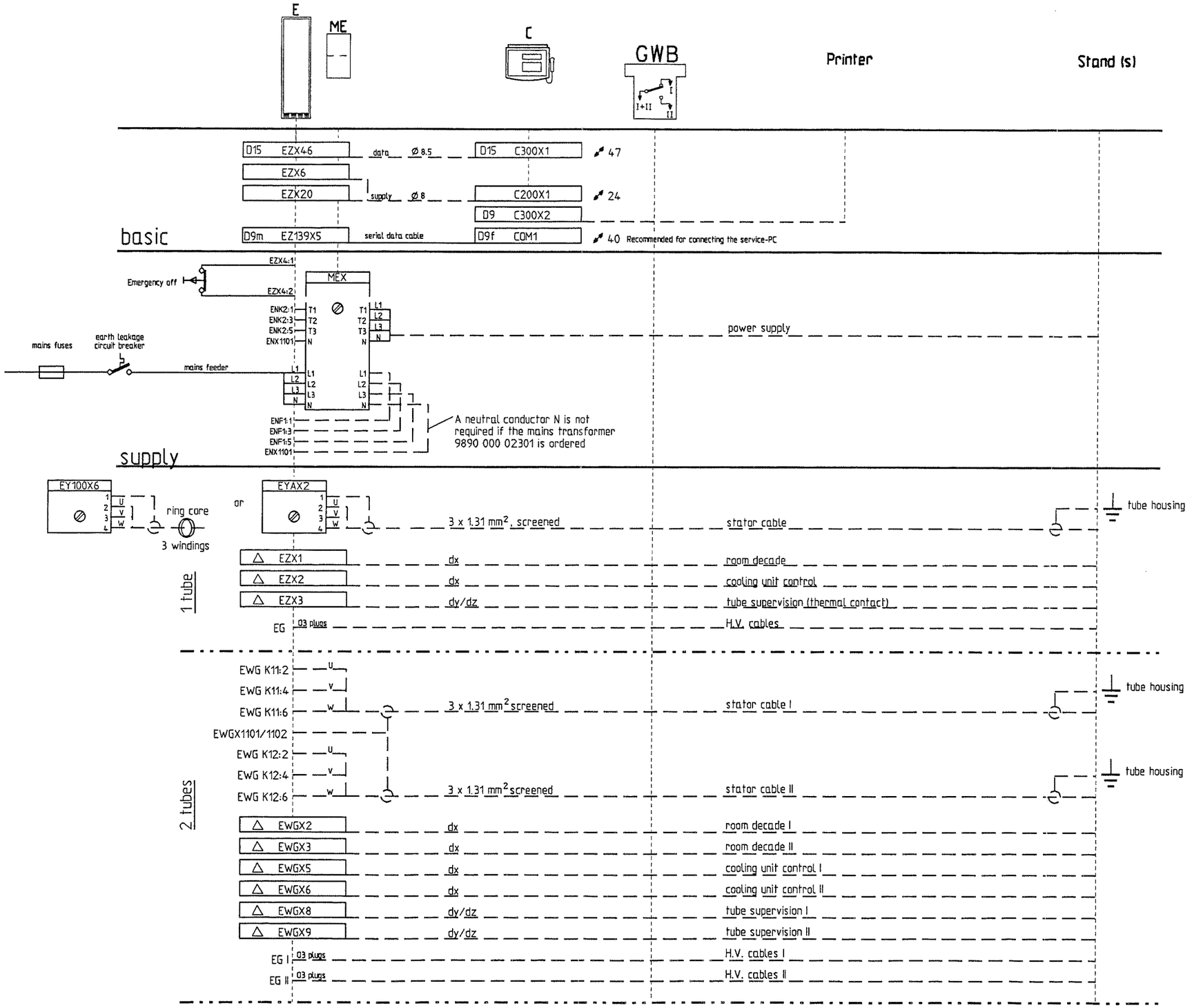

Connection diagram

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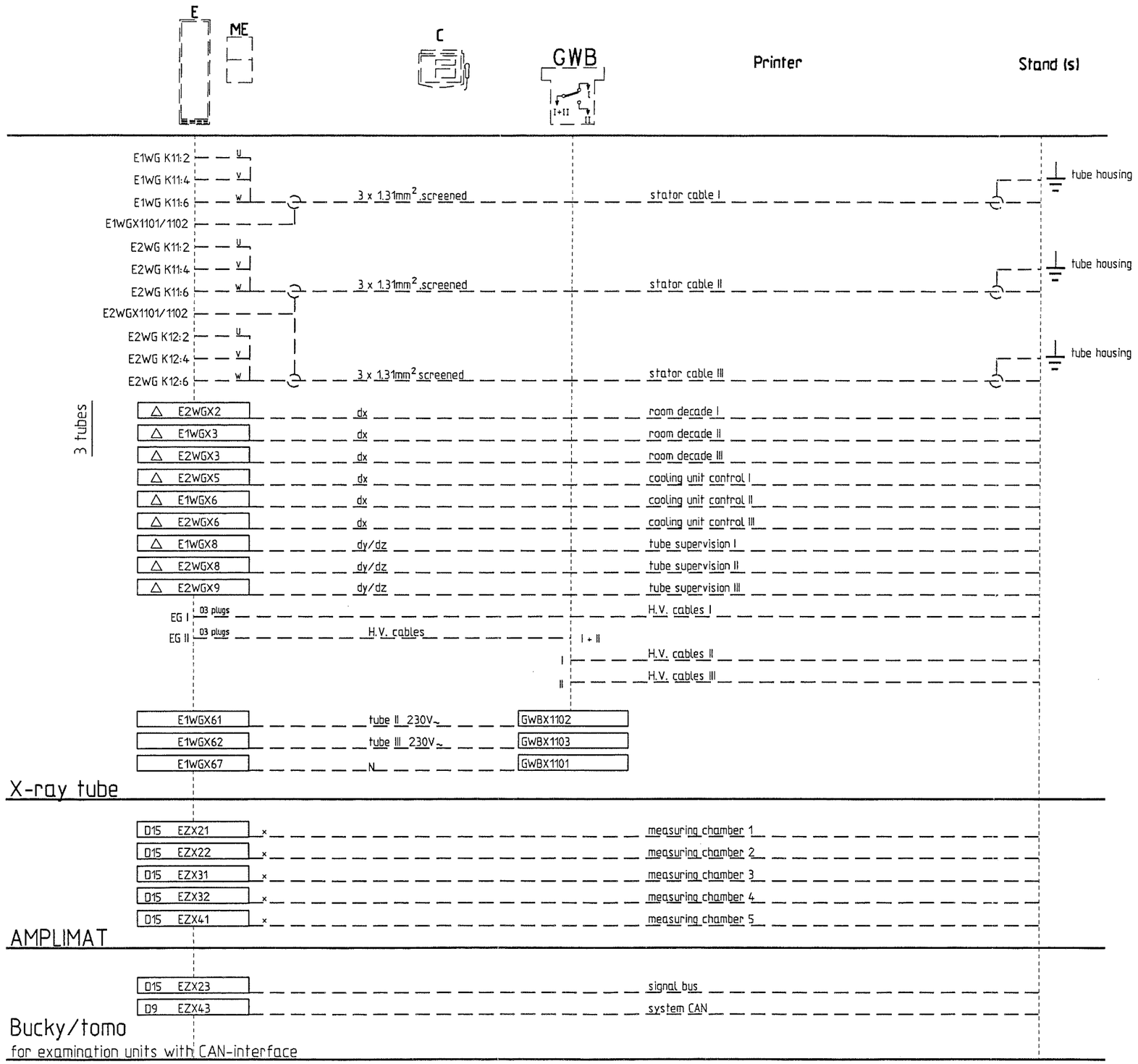
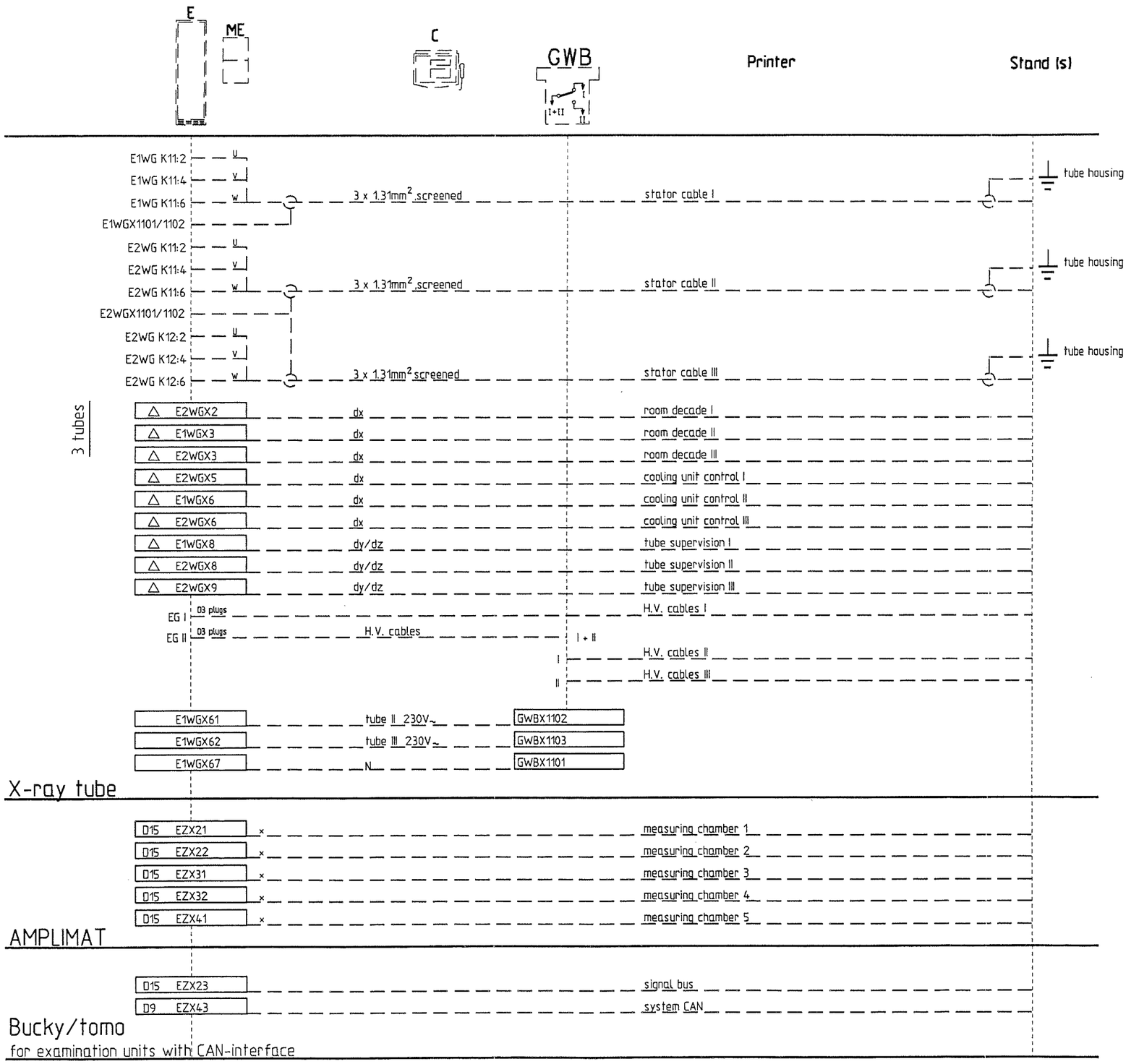


× Adapter from 3 PLUS to Sub-D connector incl. 40V generation for measuring chamber supply is available.

PRB-XRD product

A2/A3 95-04-25 Schr.
u00616

Connection diagram



× Adapter from 3 PLUS to Sub-D connector incl. 40V generation for measuring chamber supply is available.

Connection diagram

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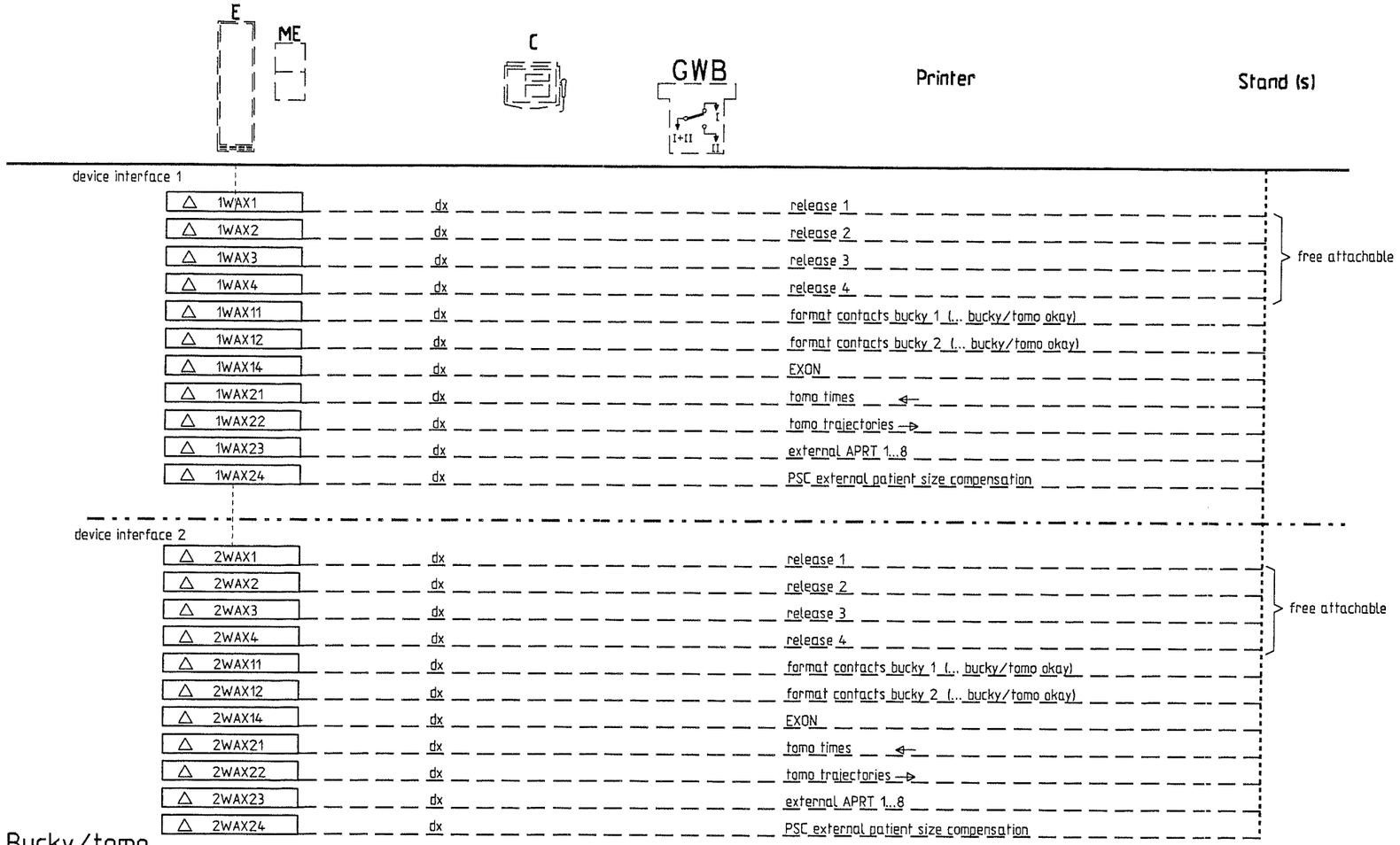

Bucky/tomo

for examination units without CAN-interface

PRB-XRD products

A2/A3 95-04-25 Schr.
u00616

Connection diagram

Z-7.3

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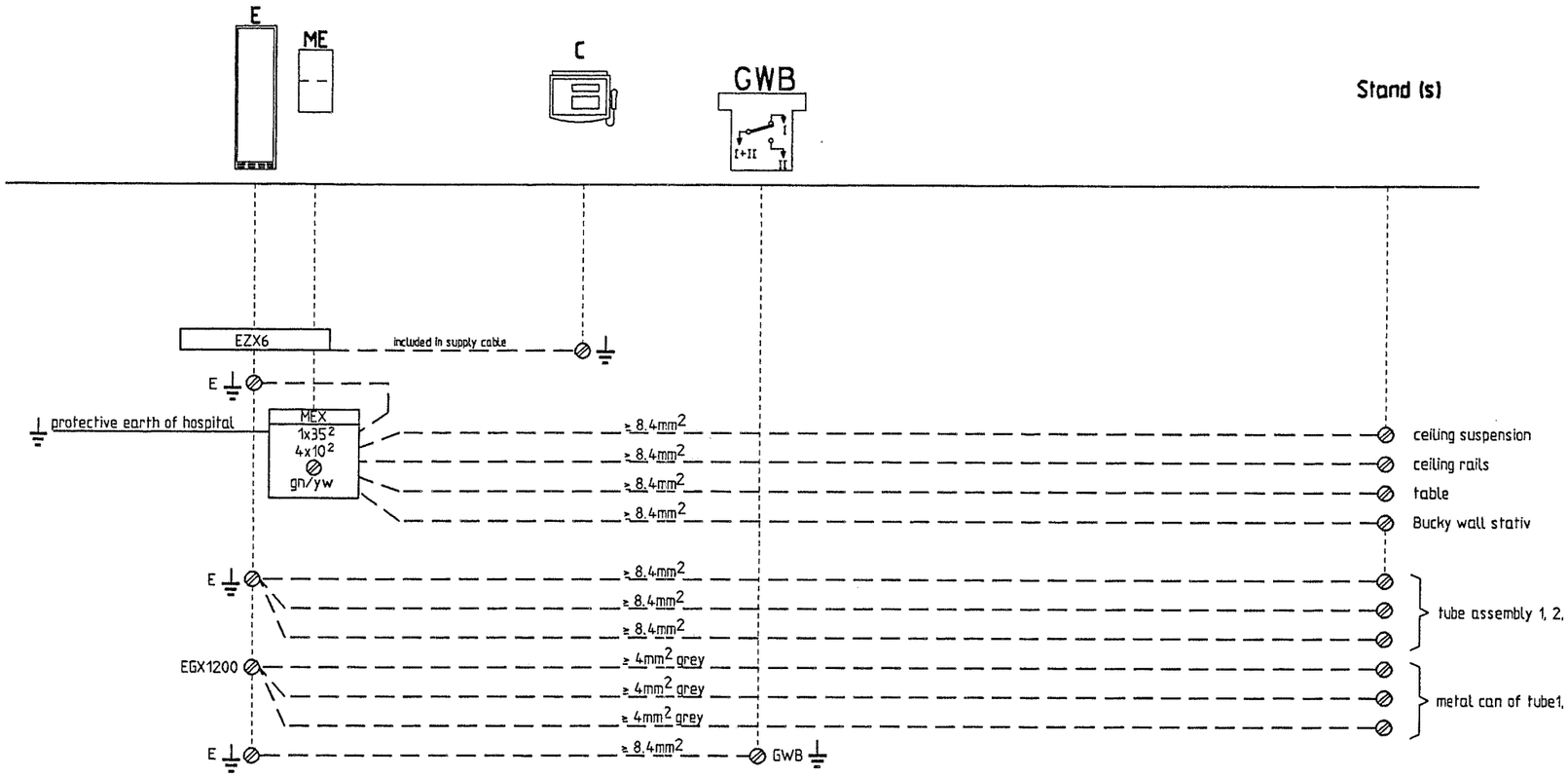

A2/A3 94-09-22 Schr.
u00616

Earthing diagram

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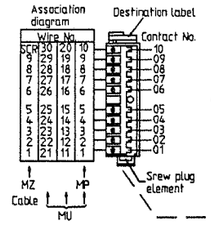
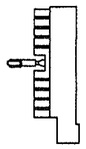
- Connection plugs

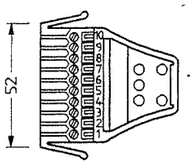
wall connection box wiring
screw plug element

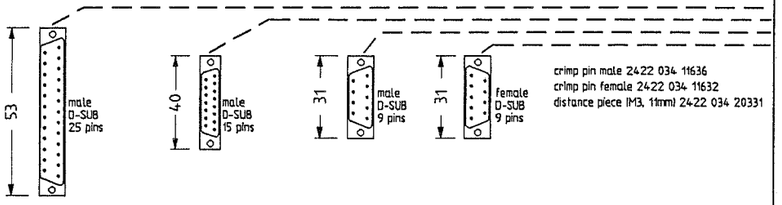


decade

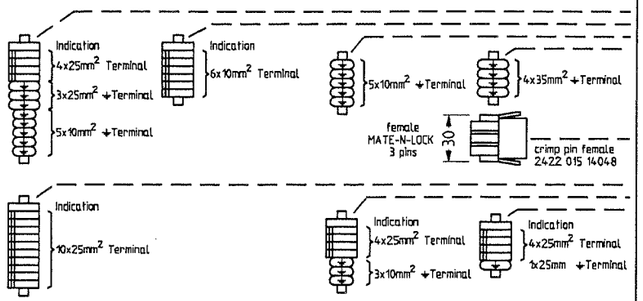


direct wiring
top decade plug element





- Connector rails



- Cables

Description		Data	Codenumber	quantity	Order in multiples of	Order quantity
M (4 x 0.75 mm²)		ø8.0	0712 164 01002	1 metre		
N (7 x 1.5 mm²)		ø13.5	0712 163 03001	1 metre		
Q (18 x 1 mm²)		ø19.0	0712 163 00001	1 metre		
R (25 x 1 mm²)		ø21.2	0712 164 10003	1 metre		
MU (34 x 1 mm²)		ø21.1	4512 152 31061	1 metre	50 metres	
MP (12 x 1.5 mm²)		ø14.1	4522 100 85001	1 metre	100 metres	
MT ((4 + 1) x 10 mm²)		ø20.5	4512 152 31201	1 metre	50 metres	
MT ((4 + 1) x 16 mm²)		ø24.5	4512 152 31161	1 metre	50 metres	
MT ((4 + 1) x 25 mm²)		ø31.0	4512 152 31181	1 metre	50 metres	
MM (5 x 2.5 mm²)		ø14.3	0722 207 04022	1 metre	100 metres	
MY ((6 + 1) x 0.5 mm² screened)		ø9.3	0722 212 02003	1 metre	150 metres	
MZ (9 x 0.82 mm² screened)		ø15.6	0722 215 16002	1 metre	150 metres	
MW (2 x 0.82 mm²)		ø6.7	0722 300 01004	1 metre	150 metres	
da (3+1 x 1.38 mm²)		ø8.0	0722 207 03044	1 metre		
db (3 x 1.3 mm² screened + y1)		ø9.2	0722 215 02054	1 metre		
dc (2 x 0.8 mm²)		ø6.2	0722 300 01011	1 metre		
dd (5 x 2 x 0.22 mm² screened)		ø7.4	0722 215 62001	1 metre		
de (12 x 2 x 0.22 mm² screened)		ø9.6	0722 215 51007	1 metre		
df (10 x 0.5 mm²)		ø7.3	4512 100 66451	1 metre		
dg (10 x 0.5 mm² screened)		ø7.8	0722 997 07248	1 metre		
dh (8 x 2 x 0.22 mm² screened + y1)		ø8.4	0722 215 33008	1 metre		
dx (10 x 0.5 mm² mushroom)		ø9.0	0722 276 05003	1 metre	150 metres	
dy (2 x 0.5 mm² mushroom , screened)		ø5.3	4512 100 66151	1 metre	150 metres	
dz (10 x 0.5 mm² mushroom , screened)		ø10	0722 215 19009	1 metre	150 metres	
(5 + 2) x 0.85 mm² stator cable		ø11.5	0722 464 02003	1 metre	150 metres	
4 x 5.2 mm² stator SRC		ø16.6		1 metre	30 metres	
1 x 4 mm² grey	(AWG 12)	ø5.4	0722 186 00536	1 metre	150 metres	
2 x 0.75 mm² screened		ø6.5	0712 187 00002	1 metre	150 metres	
3 x 0.2 mm² screened		ø6.0	0722 223 00002	1 metre	150 metres	
3 x 1.31 mm²	(AWG 16)	ø9.2	0722 215 02054	1 metre		
1 x 25 mm² PE		ø9.0	4512 152 31141	1 metre	50 metres	
1 x 16 mm² PE			4512 152 31121	1 metre	50 metres	
1 x 8.4 mm² FE/PE	(AWG 8)	ø7.6	0722 186 00503	1 metre	120 metres	
1 x 6 mm² PE			4512 152 31241	1 metre	120 metres	
1 x 4 mm² PE			0722 186 00095	1 metre	120 metres	
1 x 16.7 mm² PE		ø9.3	4512 100 66131	1 metre		
1 x 8.25 mm² PE		ø6.82	0722 186 00601	1 metre		
8 mm - measuring chamber cable	8 m		XC 5070 /08			
	12 m		XC 5070 /12			
	16 m		XC 5070 /16			
	20 m		XC 5070 /20			
	24 m		XC 5070 /24			
	28 m		XC 5070 /28			
H.V. (03 - 03, 150 kV)		ø16.5	9806 402 6xx02	(xx = length in m)		

Orderinglist

PRB- XRD

A1/A3 95-05-15 Schr.
u00624

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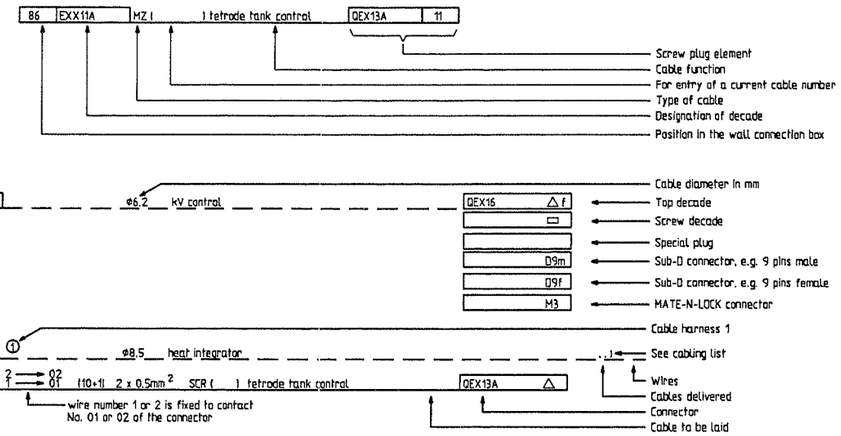
- Heading symbols

A	electronics cabinet angio
BL	electronics cabinet DSI
C	operators console
E	electronics cabinet X-ray generator
G	high tension tank frontal
GWB	H.T. changeover switch
HCU	hard copy unit
K	electronics cabinet TOMO
LA	collimator
LHCU	laser hard copy unit
MC	wcb operators console
ME	wcb electronics cabinet X-ray generator
MK	wcb electronics cabinet TOMO
MON	monitor
MR	wcb electronics cabinet
MT	connection box wall bracket
MU	overhead connection box ceiling crane
R	electronics cabinet
S	bucky table
U	ceiling crane
UB	ceiling crane longitudinal carriage
UT	wall bracket
UZ	ceiling crane
vD	vertical DIAGNOST 1/2/4
bD	bucky DIAGNOST VE/VT
VP	wcb bucky DIAGNOST

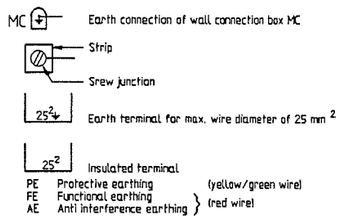
- X-ray beam symbols

BB	image intensifier
BD	image distributor
BK	I.I camera
LA	collimator
SA	film plane
WK	TV camera
XA	X-ray tube

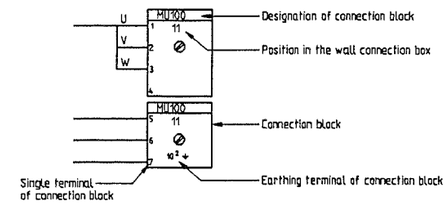
- Cable symbols



- Earthing



- Connection blocks



Legend for earthing and cabling diagram

INSTALLATION

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1. Installing the wall junction box

- Mount the wall junction box at the place where the generator is intended to be installed.
  (See drawing Z–3 in section 1 and manual UNIT 4512 103 75380 for wall junction boxes).
- If applicable, mount the filler panels of the generator to the wall junction box.
- Have the mains cable present at the clinic connected to mains terminal MEX by a person who is authorized for this job.
- Check the phase sequence of L1, L2 and L3.
- Switch off the mains supply present at the clinic and make sure that it cannot be switched on again by anyone who is not authorized to do so.

2. Mounting the H.V. generator in the cabinet

Caution!

Do not tilt the H.V. generator when transporting it!

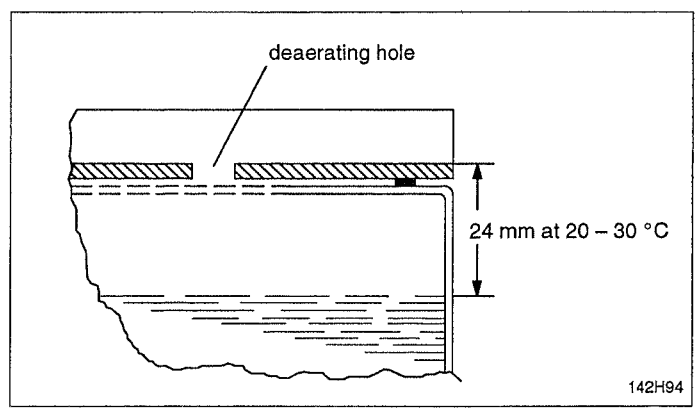
In case a tilting angle of greater than 45° has been exceeded, the setting–to–work of the generator can be started not before a waiting time of about 8 hours has passed. Otherwise the H.V. generator may be destroyed by electrical sparkover!

- Unpack generator cabinet E.
- Unpack the H.V. generator.
- In case the packing material is strongly soiled with oil, check the oil level and, if necessary, correct.

  Watch that no foreign matter falls into the oil! Otherwise the transformer must be exchanged!

  Tolerance: ±2 mm

  Oil: Shell Diala G in 2.5 l container 4512 148 43172



- Take the two transport bars from the rear side of the cabinet.
- Lift the H.V. generator into the generator cabinet with the transport bars.
- Loosen the deaerating screw by turning it 3 times counter–clockwise.

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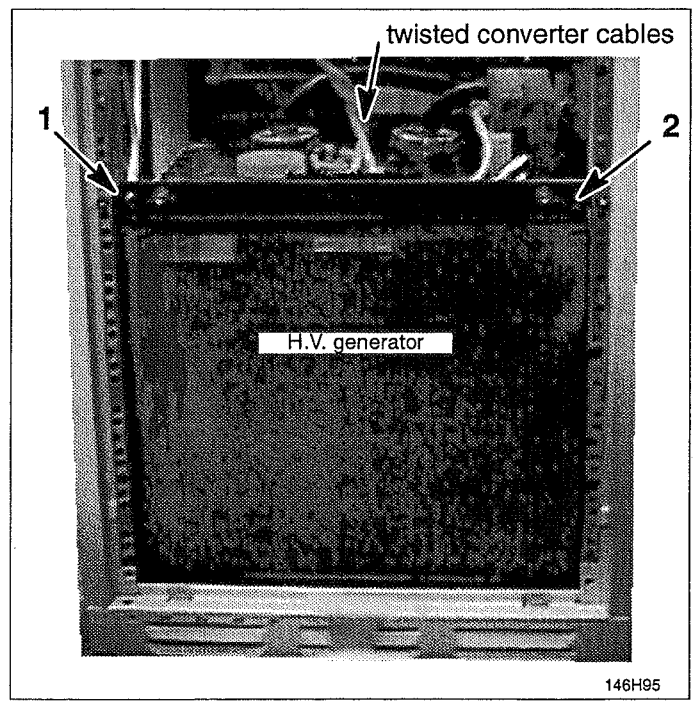
- Connect the H.V. generator electrically.

Always:	– E1 ⏚	———	GX1100 (ground)	
	– ZX12	———	G100X15	} Route the cables along the front and left–hand edge
	– ZX35	———	G100X14	} of the H.V. generator and fix them!
50 kW version:	– QC13:1	———	GX1003	} Twist the cables!
	– QC 3:1	———	GX1002	}
≥ 65 kW version:	– QC13:1	———	GX1001	} Twist the cables!
	– QC 3:1	———	GX1002	}
	– 2QC13:1	———	GX1003	} Twist the cables!
	– 2QC 3:1	———	GX1004	}
2nd tube:	– WGX61	———	GK1:1	
	– WGX67	———	GK1:2	
	– WGX62	———	GK2:1	
	– WGX68	———	GK2:2	

- Fold the two earthing angles (1, 2) of the H.V. generator outward and screw it on to the members of the cabinet.



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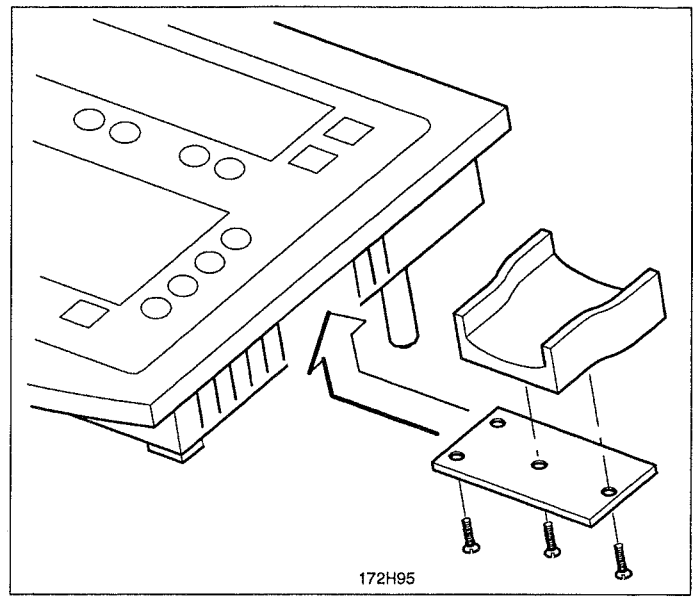
3. Installing the operating panel

Note

The scope of delivery may include a second handswitch. It can be connected to the desk by means of an adapter. Two different wall hooks are supplied as a support for the handswitch.

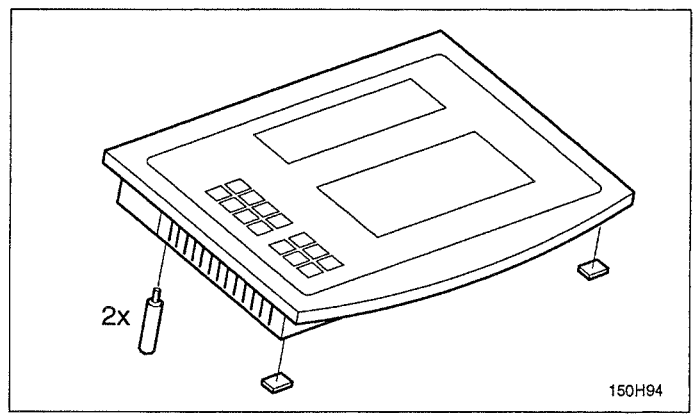


3.1. Desk version

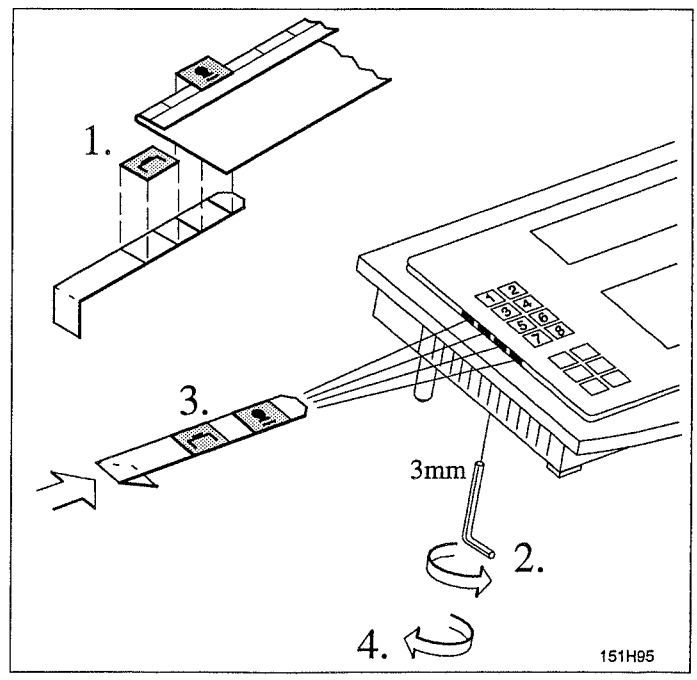
Accessories:

- 2 feet for the unit
- 2 elastic buffers, black
- 5 insert strips for the RGDV buttons
- sheet with RGDV symbols
- 1 doublesided adhesive tape
- handswitch
- support for handswitch
- mounting plate for support

- Carefully unpack the desk.
- Mount the support for the handswitch on the left–hand or right–hand side of the desk (see sketch above).
- Screw in the 2 feet for the unit at the bottom of the desk.
- Glue the 2 black elastic buffers to the front edges of the bottom of the desk such that they are acting as the front feet.



- Define the assignment of the RGDV buttons 1...8 and glue the respective symbols to the insert strips which are provided with subsidiary lines (1).
- Raise the keyboard from the bottom of the desk about 5 mm with an Allen key, 3 mm across flats (2).
- Push the insert strips under the keyboard foil. Press the angulated, protruding end of each insert strip into the housing of the desk (3).
- Lower the keyboard (4).
- Screw off the cable cover at the rear side of the desk..
- Connect the cables:
  - Supply cable EZX20 – C200X1
    EZX6 – earth
  - Data cable EZX46 – C300X1
  - Handswitch – C300X3



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- Provide drag relief for the supply and data cables with the clamp present on the desk.
- Press the sleeve providing drag relief for the handswitch cable either into the left–hand or right–hand recess in the cable cover, depending on which side the handswitch support is mounted to.
- Screw on the cable cover.
- For USA:
  Fix the handswitch with the doublesided adhesive tape to the support.
  Fixing the handswitch will guarantee that radiography cannot be released somewhere away from the desk, for instance, in the examination room.

3.2. Stand version

See Z–5 "Operating panel" in section 1.

Additional accessories:
- 4 dowels S10
- 4 hexagon cap screws 8 x 60 mm
- 4 washers

- Position the desk stand according to the respective room layout.
- Mark the fixing holes on the floor.
- Set the 4 dowels supplied into the floor (drill bit: 10 mm).
- Screw on the desk stand with 4 screws (13 mm across flats) and washers.
- Route the supply and data cables from the bottom to the top in the desk stand and provide the cables with drag relief. Cable ends including plugs should protrude beyond the edge of the desk by about 500 mm.
- Mount the support for the handswitch.
- Assign the RGDV buttons 1...8 with the desired symbols as described under 3.1.
- Connect the cables to the desk as described under 3.1.
- Screw on the cable cover.
- For USA:
  Fix the handswitch with the doublesided adhesive tape to the support.
  Fixing the handswitch will guarantee that radiography cannot be released somewhere away from the desk, for instance, in the examination room.
- Attach the operating panel on the stand.

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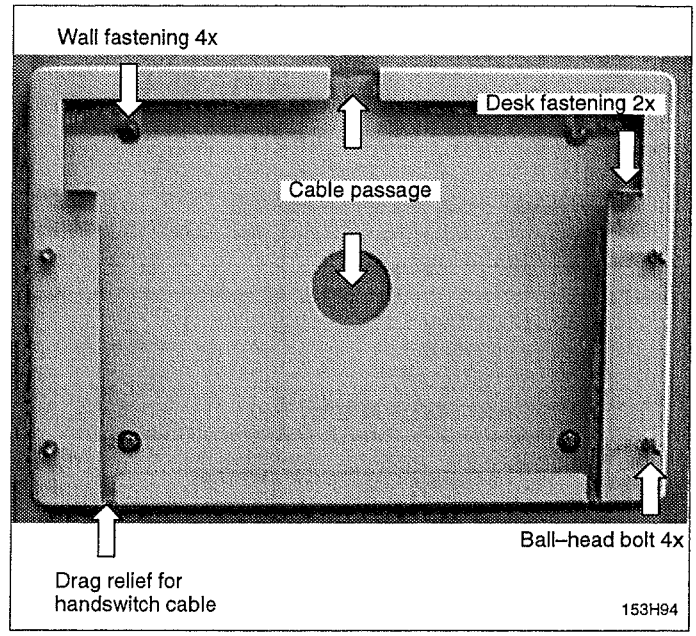
3.3. Wall mounted version

See Z–5 "Operating panel" in section 1.

Additional accessories:

- 4 ball–head bolts
- 4 dowels S8
- 4 hexagon cap screws 5 x 30 mm
- 4 washers
- 2 screws 4 x 10 mm



- Screw the 4 ball–head bolts into the wall support.
- Mark the 4 fixing holes of the wall frame at the respective place on the wall.
- Set the dowels supplied into the wall (drill bit: 8 mm).
- Screw on the wall frame with 4 screws and washers.
- Provide drag relief for the supply and data cables in the wall frame. Cable ends including plugs should protrude beyond the edge of the desk by about 500 mm.
- Mount the support for the handswitch.
- Assign the RGDV buttons 1...8 with the desired symbols as described under 3.1.
- Connect the cables to the desk as described under 3.1.
- Press the sleeve providing drag relief for the handswitch cable either into the left–hand or right–hand recess in the cable cover, depending on which side the handswitch support is mounted to.
- Attach the operating panel on the wall frame and fix it with two screws.
- Screw on the cable cover.
- For U.S.A.:

  Fix the handswitch with the doublesided adhesive tape to the support.

  Fixing the handswitch will guarantee that radiography cannot be released somewhere away from the desk, for instance, in the examination room.

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4. Electrical connection

4.1. Earthing

See Z–7.4 "Earthing diagram" in section 1.

4.2. Mains connection

See Z–7.1 "Connection diagram" in section 1.

- Measure the internal mains resistance with a suitable measuring instrument.

  L1–L2: R_i= ..... mΩ

  L1–L3: R_i= ..... mΩ

  L2–L3: R_i= ..... mΩ

  Required max. mains resistance:

Mains voltage	30 kW	50 kW	65/80 kW
190 V *		40 mΩ	–
220 V *	130 mΩ	60 mΩ	–
240 V *	160 mΩ	80 mΩ	–
400 / 440 / 460 / 480 V	500 mΩ	300 / 350 / 350 / 400 mΩ	200 / 240 / 240 / 300 mΩ

* with external mains transformer

Maximum permissible internal mains resistance: 500 mΩ

- Switch off the mains supply present at the clinic.
- Connect the mains cable of the generator to terminal MEX:L1/L2/L3 at the wall taking care that the phase sequence is correct.
- Connect the examination unit supply (max. 5 A) to terminal MEX:T1/T2/T3.

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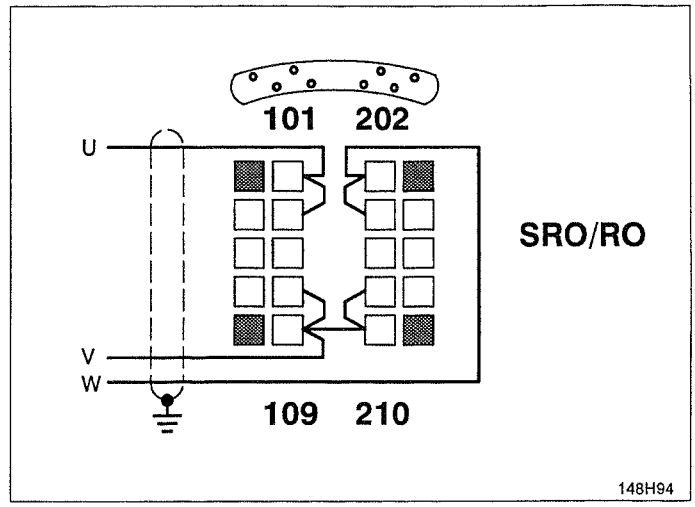
4.3. Stator connection

At the tube end:

- Place the jumpers across terminals 100 and 200 accordingly.
- Connect up stator cable.
  Use wire 1 for phase U,
  wire 2 for phase V,
  wire 3 for phase W.
- Earth the screening of the stator cable in the tube housing.



At the generator end:

See Z–7.1/2 "Connection diagram" in section 1.

- Only with high–speed rotor control and 1–tube version:
  Route the stator cable inside the generator three times through the ring core supplied (2422 525 54113).
- Check the stator connection by measuring resistance.
  U–V = wire 1 – 2 ≈ 11 Ω
  U–W = wire 1 – 3 ≈ 20 Ω
  V–W = wire 2 – 3 ≈ 9 Ω
- Connect the stator cable to the rotor control or the stator contactors of the tube extension.
  Remove the screening plate to gain access to the connection at the high–speed rotor control.
- Relieve the tension on the stator cable with a cable tie; on the rotor control assembly directly below the terminal.

Notes

– *Use screened cables. Connect the screen to earth at both ends.*
– *Do not mix up the phases, for otherwise components of the rotor control may be destroyed.*

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4.4. Signal cables

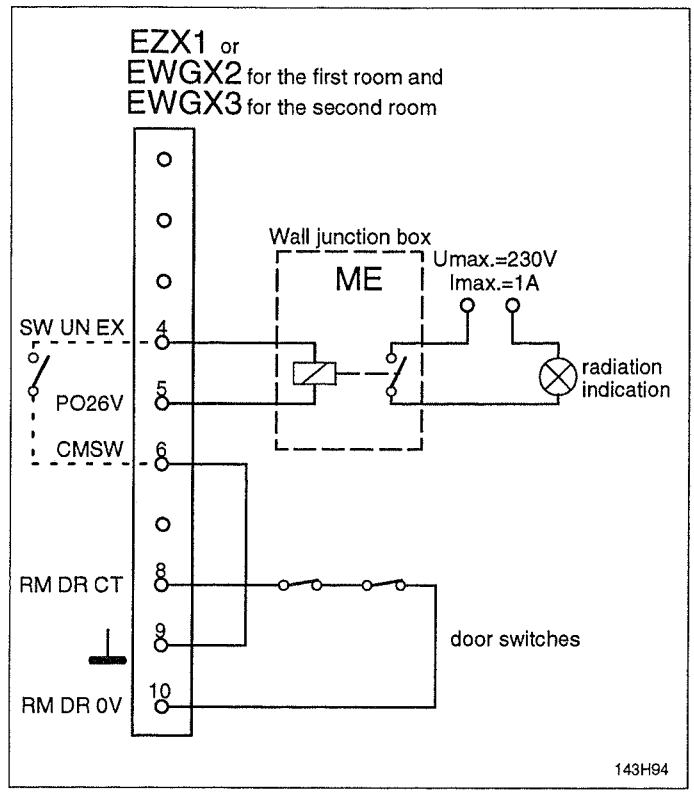
See Z–7.1/2/3 "Connection diagram" in section 1.

4.4.1. Room decade cable

- Connect the door switches at the generator. If none present, link pins 8 – 10.
- In case of need connect an external relay for each examination room to control external radiation warning devices.

  One relay inclusive cable is part of delivery.

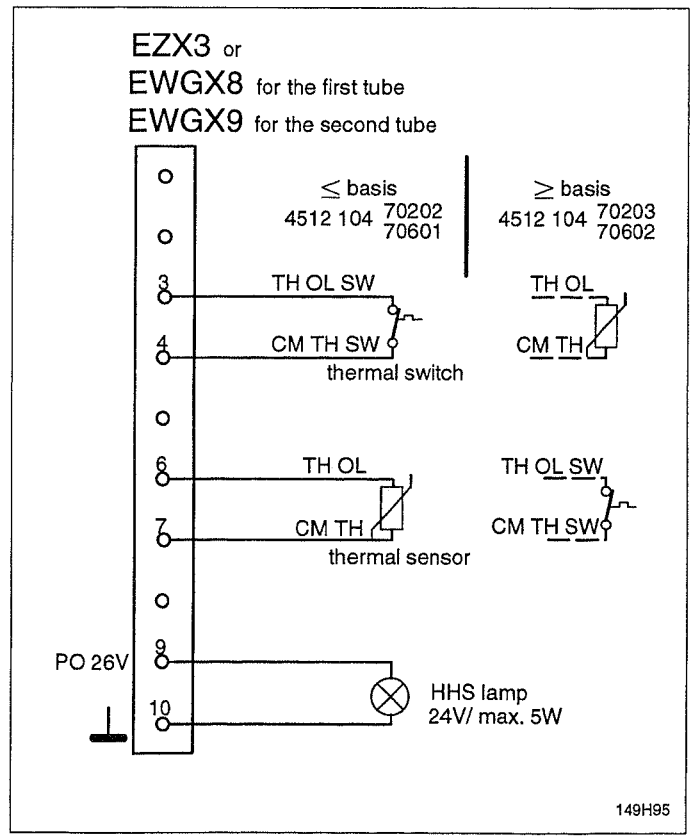
  A mounting place is reserved on the mains connection terminal MEX of the wall junction box.



4.4.2. Tube supervision

- Connect the thermal switch or the thermal sensor of the tube housing assembly.
- For U.S.A. only:

  Connect the so–called HHS–lamp to indicate the selected tube housing assembly.



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4.4.3. CAN interface

For examination units which are provided with a CAN system interface.

- EZX 23 – signalbus
- EZX 43 – system CAN

4.4.4. Adapter decade cable

For examination unit which provide their control signals separately via decade cables.

Each of the release circuits can be assigned to one or several of the RGDV buttons 1...8 via software programming.

Survey: Z1–1.2 "Block diagram, expansions"

Detail: Z1–15.1 "Adapter 4 aux. units"

4.4.5. Measuring chamber

- Connect the ALC measuring chambers directly to the Sub–D connectors EZX21/22/31/32/41. (ALC = automatic leakage compensation)
- Connect the hybrid measuring chambers via one adapter AMPLIMAT cable 9890 000 02331 each.
  The generator is supplied with: 2 adapters for 1–tube version
  3 adapters for 2–tube version

Detail: Z1–6 "Basic interface"

4.5. H.V. cables

See Z–7.1/2 "Connection diagram" in section 1.

- Mark the H.V. cables at the generator and the tube end with the correct polarity.
- Fix the H.V. cables on the left–hand side of the wall junction box on the middle rail for providing drag relief for the cables. The short ends of the H.V. cables which are going to the H.V. generator must be routed in downward direction in this area.

  The free cable lengths including plugs should be about 1.5 m.
- Twist the H.V. cables counter–clockwise by one turn and connect them to the H.V. generator.

  The twisting of the cables provides that the H.V. cables can be put into a loop when the cabinet is placed against the wall.

  The H.V. sockets should always be filled with some oil. At least the lower half of the plugs must be wet with oil.

  Do not fit a silicone washer.

  Do not rub them with silicone.

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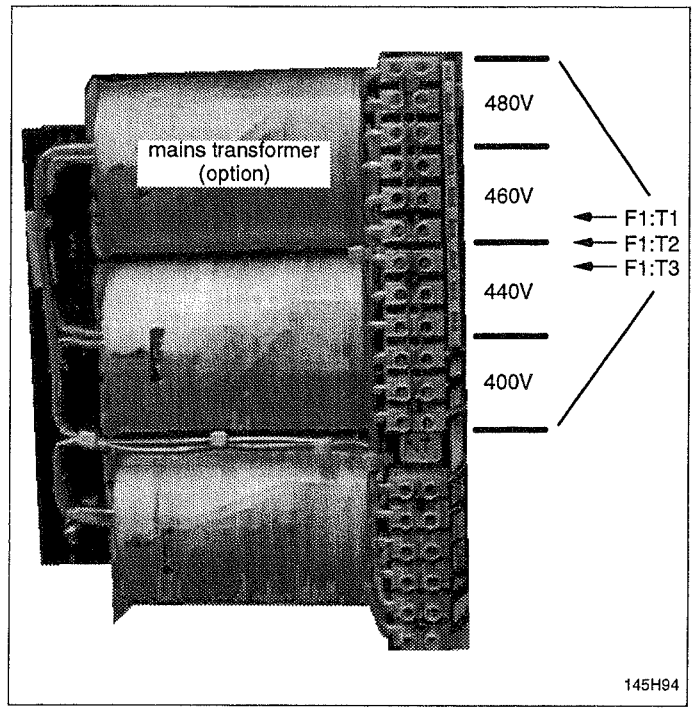
4.6. EMERGENCY–OFF circuit

- Connect the EMERGENCY–OFF buttons to EZX4:1/2.
  If not necessary, link pins 1 – 2.

5. Hardware programming

- In case mains transformer 9890 000 02301 is present in the generator, connect the primary end according to the rated voltage of the mains.



The rest of the generator hardware has been properly programmed at the factory.
If required, refer to section "Programming".

6. Switching on the generator

- Switch on the fuses present at the clinic.
- Switch on automatic circuit–breakers ENF1, ENF2 and ENF3.
  The yellow LED on EN100 POWER ON CIRCUIT must be illuminated.

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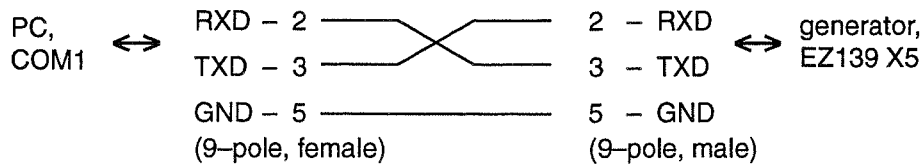
7. Using the installation software XRGSCOPE

- Provide the service PC with the hardware key and switch it on.
  The hardware key provides access to special program settings and to menu ***"Faultfind".***
- Switch the generator on.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable.



- Insert the installation disk in the PC.
- We recommend that the program be stored on hard disk (e.g. with DOS – command xcopy).
- Call the installation program with ***xrgscope*** or ***xrgscope lcd*** for PC's with LCD screen.
  The following menu line appears:

  File ***OPTIMUS*** ***Select Unit*** ***Options*** ***Help***

- Select "OPTIMUS".
  The following menu line appears:

  Program ***Adjust*** ***Accept*** ***Faultfind*** ***Quit***

General information:

– Button F1	<help>	Call help/cancel help.
– Button F2	<transmit>	Store screen contents/data set in the generator ⇒ transmit to generator.
– Button F3	<save>	Store data set on disk; the path desired can be selected.
– Button F4	<load>	Load data set from disk.
– Button Esc		Commands one step back; can be used repeatedly.
– Fields with ↓		Select the possible range of values with the RETURN button = ↵. The data are specified by the generator as fixed values.
– Fields with [...]		Input of data via the keyboard.

Error number 00L2 which appears at the beginning of the programming procedure must be erased from the screen with the RETURN button. The error number cannot be reset via the desk until a minimum exam./aux. unit and tube programming is complete. After a reset at the desk the error number reappears on the screen of the PC!
"Test" is displayed on the screen until the tube focus selected at the desk is adapted.

Note

- *Current data files, for instance, for online help, tube types, APR programming are available in BBS.*
  Product: Generatoren Hamburg
  Download area: OPTIMUS
- *If you call the installation program with* ***xrgscope ?*** *the possible starting parameters for the service program will be listed.*

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8. Setting–to–work overview

- Generator ON
- Program ... *Date and time*
  Mains data
  Tubes
- Reset the generator *with ON button at the desk or S1 on PCB EZ139*
- Program ... *Dose Rate Control/ Chamber 1...5/ Data set 1...5*
- Reset the generator
- Program ... *Registration devices/ RGDV 1...8/ Data set A ... B*
  Registration devices/ RGDV interface assignment
- Reset the generator
- Conditioning the tube
- Adjust ... *Tube adaptation (all foci)*
- Reset the generator
- Program ... *Human interface/...* —> *All changes will be visible after a reset*
  ... /Select language
  ... /RGDV related assignment/ RGDV 1 ... 8/ Predefined assignment
- Reset the generator
- Density correction *Dose Rate Control/ Chamber 1...5/ Data set 1...5* – manual programming
- Accept... *Backup*

9. Configuration

9.1. Date and time

- Select menu "*Program/* ***Date and Time***".
- Enter the respective local data.

9.2. Mains data

- Select menu "*Program/* ***Mains Data***".
- Select the nominal value of the mains voltage U. Range: 380 V, 400 V, 440 V, 480 V Default: 400 V
- Enter the maximum internal mains resistance R_i. Range: 0...500 mΩ Default: 200 mΩ

Depending on the internal mains resistance and the mains voltage the generator calculates the maximum possible output.

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9.3. Tubes

9.3.1. Tube data set

- Select menu *"Program/ Tubes/* ***Tube 1...3 Data Set****"*.
- Select with TAB and cursor–down key the respective data file from the files listed up for each tube connected, e.g. "sro 2550.tdl".
- From the list select the following possible options:
  - Upper kV limit (110, 125, 150 kV)
  - Additional cooling (WC = water cooling)
- Reset the generator with the ON button at the desk or button S1 on PCB EZ139.
  Then the data which have been configured up to now are read by the processor when the system is started.

Note
In the case of used tubes select the lowest possible upper kV limit depending on the previous use. The tube must be break in at this limit.

9.3.2. Capacitance of tube connection

- Select menu *"Program/ Tubes/* ***Capacitance tube connection****"*.
- The total capacitance for each tube connected is indicated.

C	=	½ ($C_{H.V.\ generator}$ + $C_{H.V.\ cable}$)	
$C_{H.V.\ generator}$	=	6.000 nF	
$C_{H.V.\ cable}$	=	C [pF/m] × L [m]	= specified cable capacitance × simple cable length
Default: C	=	4.550 nF	for H.V. generator + 20 m H.V. cable (155pF/m).

9.3.3. Disable tube

For correction of the configuration.

- Select menu *"Program/ Tubes/* ***Disable Tube****"*.

When the tube is disabled the above stored data set of the tube is erased. To enable the tube the tube data set has to be loaded again.

9.3.4. Tube speed selection

- Select menu *"Program/ Tubes/* ***Tube 1...3 speed selection****"*.
- Enter the required anode speed for bucky and fluoroscopy .

RO–tubes	:	bucky:	3000	fluoroscopy:	0
SRO–tubes	:	bucky:	9000	fluoroscopy:	0 or 3000
Range	:	bucky:	0 ...10000	fluoroscopy:	0 ... 4000

9.3.5. Boost modes

- Select menu *"Program/ Tubes/* ***Boost modes****"*.
- Select ... Disable = Single boost. During preparation the rated filament current is applied (default).
  Enable = Double boost. During preparation a reduced filament current is applied.
  After the release of exposure boosting takes place for a short time before the exposure is released. Effective with tube currents > 80%.

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9.4. Programming the film/screen combinations

5 film/screen combinations can be programmed for each of the 5 measuring chambers:

- Select menu *"Program/ Dose Rate Control/ Chamber 1...5/* ***Data Set 1...5"***.

  The number of the chamber corresponds to the specified unit number of the dose measuring unit.

The choice between automatic and manual DRC processing is possible when an authorized hardware key is inserted in the PC.

Automatic is selected as default and should be used for the initial programming.

Automatic DRC processing:

- Select the desired data from the files offered for the following programming steps.

  The files are part of the installation software.
  - Select the programming field with the cursor and enter <Return>.
  - Enter the desired file from the list offered.
  - Select the desired data as required.

FILM	File "film.tdl":	Film types according to description of the manufacturer.
	File "film_bl/ _gr/ _uv.tdl":	General classification of the film according to color, sensitivity S and RLF compensation.
SCREEN	File "screen.tdl":	Screen types according to description of the manufacturer.
	File "lumat_lg.tdl":	Screen types according to luminous matter.
CHAMBER	File "chamber.tdl":	Different types of measuring chambers.
CASSETTE	File "cassette.tdl":	Different types of cassettes.
SYSTEM CORRECTION	File "syscor.tdl":	Select "Low kV–correction".
CORRECTION FACTOR	Default: 1.0	Correction factor for switch–off dose.

  Based on the combination of the components entered, the processor calculates the switch–off dose, kV correction and RLF compensation and creates a name for the film/screen combination, e.g. "B400".

- Reset the generator.

Color and sensitivity class of the film/screen combination are displayed on the desk, for instance, B 400.
The other film/screen combinations (data set 1...5) for the chamber can be selected with the ± buttons.

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Manual DRC processing:

The current data set of the film/screen combination is displayed.

Abbreviation:	Abbreviation for the film/screen combination. Example: B400 = blue, intensification 400.
Dose Request Chamber:	Parameter of the measuring chamber type in [µGy/V].
Dose of FSC:	Switch–off dose of the film/screen combination in [µGy]. Linear ratio with respect to the film density.
kV70–Char. U_0...9:	Checkpoints for kV–dependent density correction.
kV70–Char. Drel_0...9:	Relative correction value for the dose.
RLF t_0...9:	Checkpoints for time–dependent density correction (RLF).
RLF Drel_0...9:	Relative correction value for the dose.

- If required, change the data.
  Usually no value except the basic density "Dose of FSC" must be changed (see chapter 13.)
- Transmit the data set with F2.
- Reset the generator.

The SAVE (F3) and LOAD (F4) functions of ***XRGSCOPE*** permit straightforward copying of the measuring chamber programmings.

9.5. Registration devices

- Select menu *"Program/ Registration devices/ RGDV 1...8/* ***Data Set A...B"***.
- Program the data set A and B of RGDV 1.....8 for all exam./aux. units desired.

Data set A:

Room:	Room number of the exam./aux. unit for room decade (radiation warning display and door contact).
Tube:	Tube assignment for the exam./aux. unit.
Mounted release circuit:	Assignment of the release unit for the exam./aux. unit (e.g.: FU ADAP A = WA/1WA or FU ADAP B = 2WA etc., also see Z1–1.2. none = free cassette.
Release circuit number:	Number of the release decade of the release unit programmed (e.g.: 1 for X1 etc., see Z1–1.2).
Enable handswitch at release circuit:	No = Operation/release via the handswitch at the desk. Yes = Release via release decade.
Syncmaster present:	E.g.: Bucky or tomo synchronous contact (20/21).
Exposure switch type:	Single step = Exposure request instantly with preparation (recommended for tube adaptation). Double step = Preparation request plus exposure request.

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Bucky format density correction:	Density correction in steps of 6%. Valid only when the assigned format contact is opened.		
Cone density correction:	Density correction in steps of 6%. Valid only when the assigned cone contact is opened.		
Dose measurement unit:	Unit 1...5	=	measuring chamber respectively at input EZX 21,22,31,32,41
	None	=	no measuring chamber assigned.
Multiple releases during preparation:	Enable	=	More than one exposure possible with the same preparation. For tomo recommended.
	Disable	=	Instant braking after exposure.
Release delay:	Disable	=	e.g. free cassette.
	Enable,	=	For AEC techniques recommended.
Mounted tomo extension:	None	=	Definition of tomography time not possible via the examination unit.
	FU ADAP_A	=	WA/ 1WAX21 valid as tomography time input (option).
	FU ADAP_B	=	2WAX21 valid as tomography time input (option).
Mounted bucky controller:	None	=	No Bucky unit is assigned to this RGDV via the system CAN interface.
	Bucky controllers 1...2	=	Bucky unit 1 or 2 is assigned to this RGDV via the CAN system interface.
APR extension ...:	Yes/No	=	External selection of APR via X23 of the respective adapter. (being prepared)
PSC extension ...:	Yes/No	=	External patient–size correction via X24 of the respective adapter (being prepared).

Data Set B:

Used for tomography:	Yes/No With "Yes" a definition of the tomography time is expected from the examination unit, e.g. via WAX21. (Option)		
Disable time input from console:	Yes/No		
Tube power usage:	1 ... 100%		
U step rate:	Single–step series	=	kV–grading in steps of 1 kV.
	Dose equivalent series	=	kV–grading corresponding to 20% density change.
Q step rate:	R10/ R20/ R40	=	mAs step width in 25, 12 or 6%.
I step rate:	R10/ R20/ R40	=	mA step width in 25, 12 or 6%.
t step rate:	R10/ R20/ R40	=	exposure time step width in 25, 12 or 6%.
Density step rate:	R10/ R20/ R40	=	density steps in 25, 12 or 6%.
Density correction:	–8 ... +8	=	correction in steps of 6% .
Underexposure display with manual techniques:	Yes	=	Underexposure is also indicated with techniques without AMPLIMAT.
	No	=	e.g. tomo

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- Select menu *"Program/ Registration devices/ RGDV Interface assignment/* ***Device interface 1...2***".
  Device interface 1 = adapter decade cable WA or 1WA (FU Adap_a)
  Device interface 2 = adapter decade cable 2WA (FU Adap_b)
- Assign the format and ready contacts of the decade connector WAX11 or WAX12 to a bucky or tomography RGDV.
  - Decade Bucky 1 (X11)

    Tomo mode switch: Disable = Input "tomo mode" is not activated. Changeover Bucky/tomography not possible via the examination unit.
    Enable = Input "tomo mode" is activated. Remote changeover Bucky/tomography possible.
    Bucky and tomo RGDV must be defined.

    Bucky RGDV – switch related: None/ RGDV 1...8
    The inputs "format contacts" and "bucky ready" are activated.
    When the tomo mode switch is enabled, this RGDV is activated when the tomo mode switch is open.

    Bucky RGDV: None/RGDV 1...8
    The inputs "format contacts" and "bucky ready" can be assigned to another RGDV button.

    Tomo RGDV – switch related: None/ RGDV 1...8
    The inputs "format contacts" and "tomo ready" are activated.
    When the tomo mode switch is enabled, this RGDV is activated when the tomo mode switch is closed.
  - Decade Bucky 2 (X12) Program the functions as for the first Bucky decade.
    But both the tomo mode switch and the tomo RGDV may not be activated twice.
  - Tomo Time 0.1 ... 6000 ms for each trajectory.
    All of the 8 must be programmed even when they are not used.

One tomography unit can be programmed for each device interface.

9.6. Example for RGDV programming

Examination unit:
- HDH without / with tomo time input (unit UP)
- Tomo programs: 1= 30°, 0.8 s (UP 6/7:01)
  2= 30°, 3.2 s (UP 6/7:02)
  3= 8°, 0.8 s (UP 6/7:03)
  4= 8°, 3.2 s (UP 6/7:04)
- Connection via Adaptor for 4 Aux. Units WA
- Ready and format contacts connected at WAX11.
- 1 tube

RGDV 1 =	Bucky	Release circuit 1 at WAX1, Measuring chamber at EZX21
RGDV 2 =	Tomography	Release circuit 2 at WAX2
RGDV 3 =	Bucky wall stand	Release circuit 3 at WAX3, Measuring chamber at EZX31
RGDV 4 =	Free cassette	– –
	/Free cassette USA	Release circuit 4 at WAX4 for free exposure interlock

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Programmings in brackets relate to the option "Automatic tomographic time input" via assembly UP of HDH.

Programmings after a stroke relate to the option "Free Exposure Interlock", which is necessary in some countries such as the USA.

Menu *"Program/ Registration devices/ ...*

RGDV #/ Data Set A	**RGDV1**	**RGDV2**	**RGDV3**	**RGDV4**
– Room:	Room 1	Room 1	Room 1	Room 1
– Tube:	Tube 1	Tube 1	Tube 1	Tube 1
– Mounted release circuit:	ADAP_A	ADAP_A	ADAP_A	None /ADAP_A
– Release circuit number:	Circuit 1	Circuit 2	Circuit 3	Circuit 4
– Enable handswitch at release circuit:	No	No	No	No
– Syncmaster present:	Yes	Yes	Yes	No / Yes
– Exposure switch type:	Double step	Double step	Double step	Double step
– Bucky format density correction:	0	0	0	0
– Cone density correction:	0	0	0	0
– Dose measurement unit:	Unit 1	None	Unit 3	None
– Multiple release during preparation:	Disable	Enable	Disable	Disable
– Release delay:	Enable	Disable	Enable	Disable
– Mounted tomo extension:	None	None(ADAP_A)	None	None
– Mounted bucky controller:	None	None	None	None
– APR extension ...:	No	No	No	No
– PSC extension ...:	No	No	No	No
RGDV #/ Data Set B				
– Used for tomography:	No	No (Yes)	No	No
– Disable time input from console:	No	No	No	No
– Tube power usage:	100 %	100 %	100 %	100 %
– U step rate:	Dose equ.series	Dose equ.series	Dose equ.series	Dose equ.series
– Q step rate:	R10	R10	R10	R10
– I step rate:	R10	R10	R10	R10
– t step rate:	R10	R10	R10	R10
– Density step rate:	R20	R20	R20	R20
– Density correction:	0	0	0	0
– Underexposure display ...:	Yes	No	Yes	Yes

Menu *"Program/ Registration devices/ ...*

Device interface 1/ Decade Bucky 1	**(WAX11)**	
– Tomo mode switch:	Disable (Enable)	(activates input at WAX11:3)
– Bucky RGDV – switch related:	RGDV 1	activates inputs at WAX11:1 and 10 for RGDV 1
– Bucky RGDV:	RGDV 3	activates inputs at WAX11:1 and 10 for RGDV 3
– Bucky RGDV:	None	
– Tomo RGDV – switch related:	RGDV 2	activates inputs at WAX11:1 and 5 for RGDV 2

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Device interface 1/ Decade Bucky 2 **(WAX12)**

- Tomo mode switch: Disable
- Bucky RGDV – switch related: None
- Bucky RGDV: None
- Bucky RGDV: None
- Tomo RGDV – switch related: None

Device interface 1/ Tomo time

– Tomo time 1:	800 ms	time setting for input at WAX21:1
– Tomo time 2:	3200 ms	time setting for input at WAX21:2
– Tomo time 3:	800 ms	time setting for input at WAX21:3
– Tomo time 4:	3200 ms	time setting for input at WAX21:4
– Tomo time 5 ... 8:	1 ms	any valid value for inputs WAX21:5...8

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10. Tube adjustment

Warning!
Radiation is released during the adjustment procedure!

The generator must be in the READY state, i.e. the green ring at the desk must be illuminated!

10.1. Tube conditioning

In case the X–ray tube has been out of operation for >6 months:

- Carry out the complete manual or automatic conditioning procedure.

In case the X–ray tube has been out of operation for 14 days ... 6 months:

- Release 20 exposures below 110 kV with maximum current.

  60 kV 4 x $I_{max.}$
  81 kV 4 x $I_{max.}$
  90 kV 4 x $I_{max.}$
  102 kV 4 x $I_{max.}$
  109 kV 4 x $I_{max.}$

- Reset the generator.

Example RO 17 50:

In the event of electrical irregularities reduce the voltage by 10 kV and initiate a few switching actions, afterwards proceed with the program.

If trouble continues to occur at voltages > 110 kV, start from 80 kV again.

- Select a registration device for tube 1 on the operating desk.

- Release one exposure of each kV stage. Give 20 s pause between the exposures.

Large focus:

60 kV	700 mAs
81 kV	640 mAs
90 kV	560 mAs
102 kV	500 mAs
109 kV	470 mAs
117 kV	440 mAs
125 kV	400 mAs

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- Release one exposure of each kV stage.

Large focus:

kV max.	=	125 kV
81 kV		64 mAs
90 kV		56 mAs
102 kV		50 mAs
109 kV		47 mAs
117 kV		44 mAs
125 kV		40 mAs

kV max.	=	150 kV
81 kV		62 mAs
102 kV		50 mAs
109 kV		47 mAs
117 kV		44 mAs
125 kV		40 mAs
133 kV		38 mAs
141 kV		36 mAs
150 kV		33 mAs

- Select the small focus.
- Release two exposures of each kV stage.

Small focus:

kV max.	=	125 kV
81 kV		21 mAs
90 kV		19 mAs
102 kV		17 mAs
109 kV		16 mAs
117 kV		15 mAs
125 kV		14 mAs

kV max.	=	150 kV
81 kV		21 mAs
102 kV		17 mAs
109 kV		16 mAs
117 kV		15 mAs
125 kV		14 mAs
133 kV		13 mAs
141 kV		12 mAs
150 kV		11 mAs

- Proceed equally for tubes 2 and 3.
- Reset the generator.

10.2. Adaptation of the tube

Adaptation is an automatic process which has to be performed for each focus of all the tubes connected.

Boost Adaptation, where the inertia of the filament with respect to heating up and cooling down is registered, is integrated into this process.

In case an error message occurs during the adaptation procedure, reset the generator and repeat the adaptation for this particular focus.

Recommendation: Program the handswitch temporary via menu *"... / **RGDV 1/ Data Set A**"* to "single step".

- Select menu *"Adjust/ **Tube Adaptation**"*.
- Select the tube to be adapted and the focus to be adapted.
  Start with the small focus!
- Press button F2.
  - "Adap" is displayed on the desk.
  - "Waiting" is displayed on the screen.
- Wait until the generator is in the READY state.

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- Start the adaptation procedure by pressing the handswitch continuously.

  The generator carries out adaptation of the focus automatically. It may happen that the red LED on the desk lights up for a short time.

  The tube adaptation of the focus is complete when "Adap" has disappeared on the desk and "Test" is displayed.
- Let go of the handswitch.
- Reset the generator.
- Repeat the adaptation procedure for each additional focus and tube.

11. Tube limits

If required for applicational reasons, the working range of the tubes connected can be restricted.

- Select menu "*Program/ Tubes/* ***Tube Limits***".
- Program the following parameters for each tube and focus:
  - Min./max. kV.
  - Min./max. mA.

The foci of all tubes are numbered consecutively:

– 1/9:	small focus	1st tube
– 2/9:	medium focus	1st tube
– 3/9:	large focus	1st tube
– 4/9:	small focus	2nd tube etc.

The values programmed are the limit values for applications. They are not effective during tube adaptation.

12. Programming the operating desk

A maximum of up to 1024 APRs can be stored in the generator.

On a single RGDV button either up to 80 APRs can be programmed directly (10 pages of 8 each) or up to 250 APRs via menus.

The initial data sets are called ### APR name ### and they have the same exposure parameters.

They can be directly assigned or via menu and submenu levels to registration devices RGDV 1...8.

In case "Test APR" is displayed after selection of a registration device, at least this particular registration device has not been assigned to any APRs.

12.1. Language

The language for operating instructions is selected in this menu.

- Select menu "*Program/ Human Interface/* ***Select Language***".
- Select the desired language:
  - English = GB
  - German = D
  - French = F
  - Spanish = E

The following table lists which characters can be displayed on the control desk and how they can be indicated/entered at the service PC, e.g. for APR names.

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Certain characters can be generated at the PC only via the decimal code. To do so, press the "Alt" key on the PC and enter the numerical code.

Character display on the control desk				Possible PC display (code 850)	Input at the PC
English	German	French	Spanish		
!	!	!	!	!	
#	#	£	£	#	
$	$	$	$	$	
%	%	%	%	%	
&	&	&	&	&	
'	'	'	'	'	
(	(	(	(	(	
)	)	)	)	)	
*	*	*	*	*	
+	+	+	+	+	
,	,	,	,	,	
–	–	–	–	–	
.	.	.	.	.	
/	/	/	/	/	
0	0	0	0	0	
1	1	1	1	1	
2	2	2	2	2	
3	3	3	3	3	
4	4	4	4	4	
5	5	5	5	5	
6	6	6	6	6	
7	7	7	7	7	
8	8	8	8	8	
9	9	9	9	9	
:	:	:	:	:	
;	;	;	;	;	
<	<	<	<	<	
=	=	=	=	=	
>	>	>	>	>	
?	?	?	?	?	
@	§	à	§	@	
A	A	A	A	A	
B	B	B	B	B	
C	C	C	C	C	
D	D	D	D	D	
E	E	E	E	E	
F	F	F	F	F	
G	G	G	G	G	
H	H	H	H	H	
I	I	I	I	I	
J	J	J	J	J	
K	K	K	K	K	

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Character display on the control desk				Possible PC display (code 850)	Input at the PC
English	German	French	Spanish		
L	L	L	L	L	
M	M	M	M	M	
N	N	N	N	N	
O	O	O	O	O	
P	P	P	P	P	
Q	Q	Q	Q	Q	
R	R	R	R	R	
S	S	S	S	S	
T	T	T	T	T	
U	U	U	U	U	
V	V	V	V	V	
W	W	W	W	W	
X	X	X	X	X	
Y	Y	Y	Y	Y	
Z	Z	Z	Z	Z	
[	Ä	.	i	[	
\	Ö	ç	Ñ	\	
]	Ü	§	¿	]	
^	^	^	^	^	
_	_	_	_	_	
'	'	'	'	'	
a	a	a	a	a	
b	b	b	b	b	
c	c	c	c	c	
d	d	d	d	d	
e	e	e	e	e	
f	f	f	f	f	
g	g	g	g	g	
h	h	h	h	h	
i	i	i	i	i	
j	j	j	j	j	
k	k	k	k	k	
l	l	l	l	l	
m	m	m	m	m	
n	n	n	n	n	
o	o	o	o	o	
p	p	p	p	p	
q	q	q	q	q	
r	r	r	r	r	
s	s	s	s	s	
t	t	t	t	t	
u	u	u	u	u	
v	v	v	v	v	
w	w	w	w	w	
x	x	x	x	x	

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Character display on the control desk				Possible PC display (code 850)	Input at the PC
English	German	French	Spanish		
y	y	y	y	y	
z	z	z	z	z	
{	ä	é	▪	{	Alt +123
¦	ö	ù	ñ	¦	Alt +124
}	ü	é	Ç	}	Alt +125
~	ß	–	~	~	Alt +126
				Δ	Alt +127
◢	◢	◢	◢	á	Alt +160
■	■	■	■	í	Alt +161
⊢	⊢	⊢	⊢	ó	Alt +162
£	£	£	£	ú	Alt +163
▪	▪	▪	▪	ñ	Alt +164
§	§	§	§	º	Alt +167
ⅢⅢ	ⅢⅢ	ⅢⅢ	ⅢⅢ	¿	Alt +168
‖	‖	‖	‖	®	Alt +169
≣	≣	≣	≣	¬	Alt +170
≡	≡	≡	≡	½	Alt +171
					Alt +172
					Alt +173
					Alt +174
					Alt +175
°	°	°	°	▒	Alt +176
±	±	±	±	▒	Alt +177
2	2	2	2	■	Alt +178
À	À	À	À	└	Alt +192
Á	Á	Á	Á	⊥	Alt +193
Â	Â	Â	Â	┬	Alt +194
Ã	Ã	Ã	Ã	├	Alt +195
Ä	Ä	Ä	Ä	─	Alt +196
Å	Å	Å	Å	┼	Alt +197
Æ	Æ	Æ	Æ	ã	Alt +198
Ç	Ç	Ç	Ç	Ã	Alt +199
È	È	È	È	╚	Alt +200
É	É	É	É	╔	Alt +201
Ê	Ê	Ê	Ê	╩	Alt +202
Ë	Ë	Ë	Ë	╦	Alt +203
Ì	Ì	Ì	Ì	╠	Alt +204
Í	Í	Í	Í	═	Alt +205
Î	Î	Î	Î	╬	Alt +206
Ï	Ï	Ï	Ï	¤	Alt +207
				δ	Alt +208
Ñ	Ñ	Ñ	Ñ	Đ	Alt +209
Ò	Ò	Ò	Ò	Ê	Alt +210
Ó	Ó	Ó	Ó	Ë	Alt +211
Ô	Ô	Ô	Ô	È	Alt +212

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Character display on the control desk				Possible PC display (code 850)	Input at the PC
English	German	French	Spanish		
Õ	Õ	Õ	Õ	ı	Alt +213
Ö	Ö	Ö	Ö	ſ	Alt +214
				ˆ	Alt +215
Ø	Ø	Ø	Ø	˜	Alt +216
Ù	Ù	Ù	Ù	¯	Alt +217
Ú	Ú	Ú	Ú	˘	Alt +218
Û	Û	Û	Û	˙	Alt +219
Ü	Ü	Ü	Ü	¨	Alt +220
Ý	Ý	Ý	Ý	¸	Alt +221
				˝	Alt +222
ß	ß	ß	ß	˛	Alt +223
à	à	à	à	Ó	Alt +224
á	á	á	á	ß	Alt +225
â	â	â	â	Ô	Alt +226
ã	ã	ã	ã	Ò	Alt +227
ä	ä	ä	ä	õ	Alt +228
å	å	å	å	Õ	Alt +229
æ	æ	æ	æ	µ	Alt +230
ç	ç	ç	ç	Þ	Alt +231
è	è	è	è	þ	Alt +232
é	é	é	é	Ú	Alt +233
ê	ê	ê	ê	Û	Alt +234
ë	ë	ë	ë	Ù	Alt +235
ì	ì	ì	ì	ý	Alt +236
í	í	í	í	Ý	Alt +237
î	î	î	î	¯	Alt +238
ï	ï	ï	ï	´	Alt +239
					Alt +240
ñ	ñ	ñ	ñ	±	Alt +241
ò	ò	ò	ò	‗	Alt +242
ó	ó	ó	ó	¾	Alt +243
ô	ô	ô	ô	¶	Alt +244
õ	õ	õ	õ	§	Alt +245
ö	ö	ö	ö	÷	Alt +246
				¸	Alt +247
ø	ø	ø	ø	°	Alt +248
ù	ù	ù	ù	¨	Alt +249
ú	ú	ú	ú	·	Alt +250
û	û	û	û	¹	Alt +251
ü	ü	ü	ü	³	Alt +252
ý	ý	ý	ý	²	Alt +253
				■	Alt +254
					Alt +255

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12.2. Automatic programming of APRs

The installation disk contains data files for a complete, typical APR programming in different languages.

Standard APR programs for each application can easily and quickly be loaded for each registration device.

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/* ***Predefined assignment****"*.
- Select one of the files listed up, e.g. "ar65eng.tdl".

  Meaning:

a	=	APR data file	
r	=	radiography	
65	=	version (month/year)	
m	=	mono focus tube	
p	=	pediatrics	
v	=	with VARIOFOCUS settings	
eng	=	language;	en(g) = English, de(u) = German, es(p) = Spanish, fr(a) = French

- Select one of the applications listed up, e.g. "Bucky", and load the data file.

  Extension GR = Group; APRs are divided into groups (menu technique),

  Extension PA = Paging; APRs are assigned directly to an application.
- Repeat this procedure for each registration device.
- Reset the generator.

  Now all APR programs which have been loaded are displayed on the desk.

If required:

- Change the name and the contents of the APRs according to 12.4.
- Change the menus and the assignment of the APRs according to 12.3.

Note

In case a complete APR program setting is to be replaced by another program setting, all other APR program settings under the registration device concerned must be deleted first.

For deleting a program setting call menu "Program/Human interface/RGDV related assignment/RGDV 1...8/Manual assignment/ ***Delete menu****" and select the blank line.*

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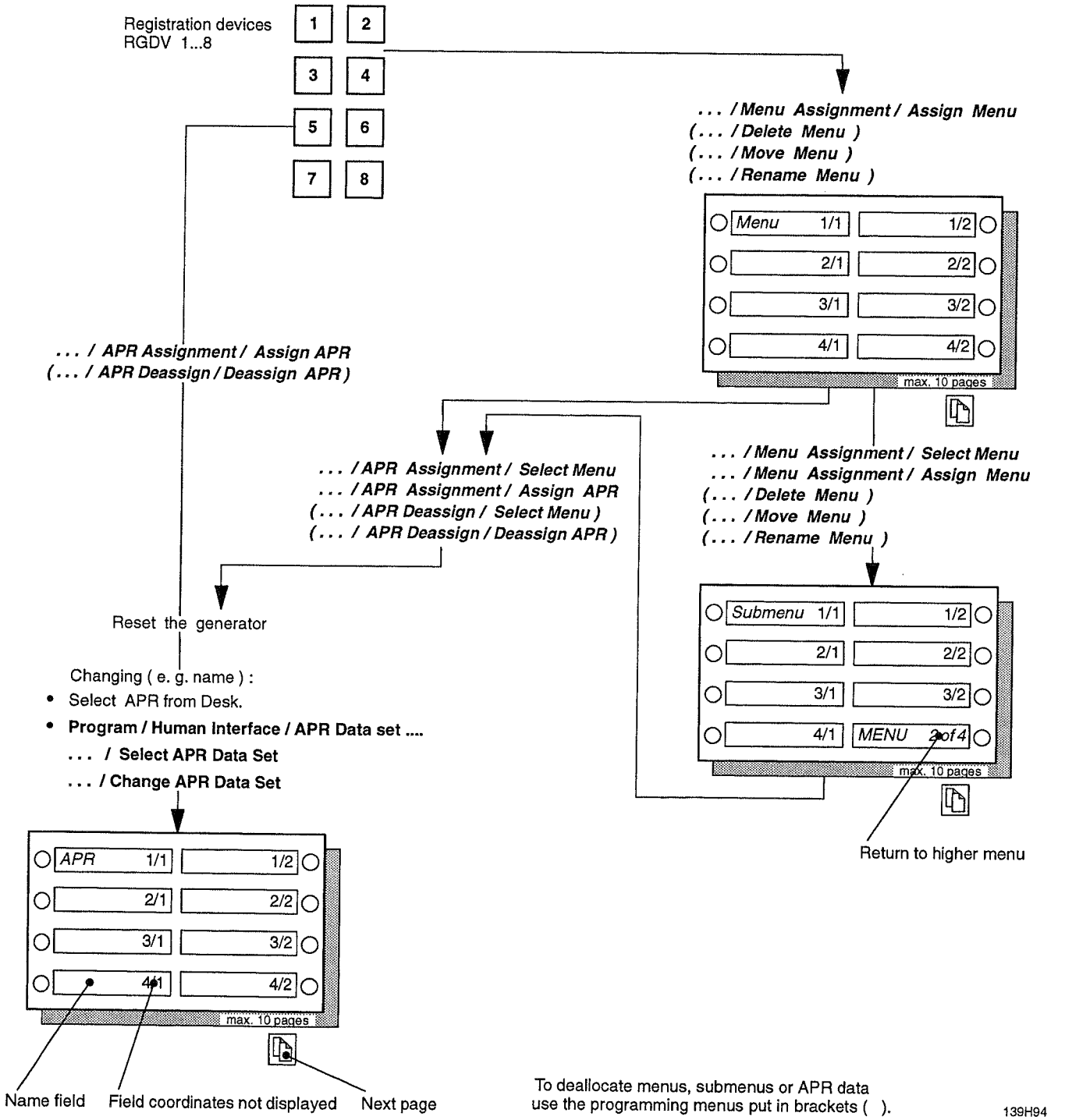
12.3. Manual programming of APRs

Manual APR and menu assignment possibilities

- Select service menu ***Program/ Human Interface/ RGDV Related Assignment/ RGDV 1...8 /Manual Assignment ...***



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12.3.1. Creating menus

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Assign menu***".
- Enter the first menu name, e.g. "Body region 1".
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Enter the second menu name, e.g. "Body region 2".

Etc.

12.3.2. Creating sub menus

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Select menu***".
- Select with the cursor from one of the windows a menu to be assigned with submenus.
- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Assign menu***".
- Enter the first submenu name, e.g. "Left side".
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Enter the second submenu name, e.g. "Right side".

Etc.

12.3.3. Creating or assigning APRs

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR assignment/* ***Select menu***".
- Select with the cursor from one of the windows a menu or submenu.
  If no menu layer is desired, proceed to assign APR.
- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR assignment/* ***Assign APR***".
- Select from one of the windows an initial APR or an APR which has not been assigned.
  Initial APR: "### APR name ###
  Not assigned APR: e.g. "Thorax ap"
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Assign the next APR.

Etc.

- Reset the generator.

Only after a reset of the generator the menus, submenus and APRs are displayed on the desk.

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12.4. Changing of APRs

- Select the APR to be changed on the desk, e.g. ### APR name ###.
- Select menu *"Program/ Human interface/ APR data set/* ***Select APR data set****"*.
  The number of the APR selected on the desk is displayed. Transmit data with <F2>.
- Select menu *"Program/ Human interface/ APR data set/* ***Change APR data set****"*.
- Change the contents of the APR, e.g. name, kV etc.

APR number:		1 ... 1024
APR name:		up to 16 characters
Focus:	*	small/ middle / vario/ large
Vario focus ratio [%]:		20%, 35%, 50%, 65%, 80%
Dose measurement field (left)	*	on/ off
Dose measurement field (middle)	*	on/ off
Dose measurement field (right)	*	on/ off
Preferred technique:		AEC/ No AEC preferred
AEC technique:		RAEC
No AEC technique:		RUIT/ RUQ/ RUQT
Ie max .factor [%]:		1 ... 100
PSC U thin (dose equiv. steps):		0 ... 5
PSC U thick (dose equiv. steps):		0 ... 5
PSC Q thin (6% steps):		0 ... 10
PSC Q thick (6% steps):		0 ... 10
PSC dens. thin (6% steps):		0 ... 10
PSC dens. thick (6% steps):		0 ... 10
Exposure data U [kV]:	*	20 ...150
Exposure data I [mA]:	*	0.1 ... 2000
Exposure data Q [mAs]:	*	0.001 ... 1000
Exposure data density (6% steps):	*	–16 ... +16
Exposure data t [ms]:	*	1 ... 60000
Film screen comb.:	*	RGDV–dependent; Default = Data Set 1
Tomo No.:		1 ... 8 assignment of a tomographic figure
Spectral Filter:		none/ 2mm Al/ 0.1mm Cu + 1mm Al / 0.2mm Cu + 1mm Al; Default = none

AEC	=	Automatic Exposure Control
RAEC	=	AEC for radiography
RUIT	=	mA–s technique for radiography
RUQ	=	mAs technique for radiography
RUQT	=	mAs–s technique for radiography

- Transmit data with <F2>.
- Select the next APR on the desk, select it in the programming menu and change it.

Etc.

- Reset the generator.

* The basic setting of this data can also be performed from the desk ("Reset" + APR). Refer to the operator's manual.

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12.5. Moving/copying of an APR data set

Determination of the number of APR data set "x" to where APR data set "y" is to be moved/copied.

- Select APR data set "x" on the desk.
- Select menu *"Program/ Human Interface/ APR Data Set/* ***Select APR Data Set****".*
- Note the number of APR data set "x", for instance, 100.

Changing of the number of APR data set "y" to be moved/copied to the number of APR data set "x"

- Select APR data set "y" on the desk.
- Select menu *"Program/ Human Interface/ APR Data Set/* ***Select APR Data Set****".*
  Transmit with F2.
- Select menu "*Program/ Human Interface/ APR Data Set/* ***Change APR Data Set****".*
- Replace the number of APR data set "y" with the number of APR data set "x" in the input mask, for instance, nnn ⇒ 100.
- Transmit this number with F2 and reset the generator.

APR data set "y" is displayed in place of the old APR data set "x" on the desk.
In case APR data set "y" is merely moved and not copied to the location of APR data set "x", the original APR data set "y" must be deleted at the end of programming.

12.6. Deleting of APRs

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR deassign/* ***Select menu****".*
  Required only when the APR is assigned to a menu or submenu.
- Select the associated menu or submenu from one of the windows.
- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ APR deassign/* ***Deassign APR****".*
- Select the APR to be deleted from one of the windows.
- Reset the generator.

An APR which has been deleted is no longer displayed on the desk but remains stored in the generator. It can be re–activated according to 12.3.3..

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12.7. Manipulating menus

Deleting:

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Delete menu****"*.
- Select the menu or submenu to be deleted from one of the windows.
  For deleting a complete APR program select the blank line.
- Reset the generator.

Shifting:

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Move menu****"*.
- Select the menu or submenu from one of the windows.
- Enter the new positions.
- Reset the generator.

Re–naming:

- Select menu *"Program/ Human interface/ RGDV related assignment/ RGDV 1...8/ Manual assignment/ Menu assignment/* ***Rename menu****"*.
- Select the menu or submenu from one of the windows.
- Enter the name in the lowermost line.
- Reset the generator.

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13. Density correction

13.1. Density correction for AEC technique

Basic density per film/screen combination:

A hardware key is required at the PC for direct access to the switch–off dose.

- Make a sample exposure for each film/screen combination.
  To do so, select APRs with density correction "0".
- Determine density of the sample exposures.
- Select menu *"Program/ Dose rate control/ Chamber 1...5 /* ***Data set 1...5****"*.
- Select manual DRC programming with <Escape>.
- Correct the switch–off dose FSC according to formular below:

$$\text{New switch–off dose} = \frac{\text{Desired density}}{\text{Measured density}} * \text{Old switch–off dose}$$

- Transmit the data set with F2.
- Repeat the procedure for each ensuing film/screen combination.
- Reset the generator.

The switch–off dose can be set on the PC even without a hardware key.
To do so, call up the automatic DRC programming, repeat all the selections and change the correction factor for switch–off dose accordingly. Each time this programming is called up all the selections must be repeated.

Organ–dependent correction:

- Select the APR to be changed on the desk.
- Select menu *"Program/ Human interface/ APR data set/* ***Select APR data set****"*.
  Confirm the APR number displayed with <Transmit>.
- Select menu *"Program/ Human interface/ APR data set/* ***Change APR data set****"*.
- Exposure data density: –8 ... +8 = correction in steps of 6%.
- The number of correction steps must be matched to the programmed step length of the desk display.
  Example:
  The desk display has been programmed to the R20 series (=12%) in the menu ***"Program/Registration devices/RGDV 1...8/Data Set B/Density step rate"***. To be able to display a density correction of +1 for a certain APR two corrections steps (2x6% = 12%) must be programmed under this APR.
- Select the next APR on the desk, select it in the programming menu and change it.

Etc.

- Reset the generator.

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Correction for each RGDV 1...8:

This correction is possible but for reasons of clarity it should not be used.

- Select menu *"Program/ Registration Devices/ RGDV 1...8/* ***Data set B****"*.
- Density correction: –8 ... +8 = correction in steps of 6%.

13.2. Density correction for non–AEC techniques

The supplied APR standard sets are based mostly on a film/screen combination with an intensification of 400.
ARP for extremities and some other applications are based on a 100 or 200 type system. Depending on the local situation the "mAs" or "s" parameters of all the relevant APRs must be adapted.
Example:
The customer uses a 200 type system. To change from the existing "400" values the relevant APRs must be reprogrammed to double the mAs products or to double the exposure time (400 divided by 200=2).

- Select the relevant APR at the control desk.
- Set the new parameters at the control desk.
- Save the new parameters as default values. To do this press the "Reset" button and the corresponding APR button. The asterisk in the APR name as an indication of overwritten data disappears.

14. Interlock facility for APR modification

Using the menu ***"Program/ Human Interface/APR modifiable by User"*** it is possible to prevent a customer from being able to store APR modifications as default setting via the control desk.

15. VARIOFOCUS (option)

For the VARIOFOCUS option, special APR files have to be loaded. These are designated with a "v" in the file name and contain correspondingly defined APRs.

VARIOFOCUS is programmed as a percentage mix of the small focus with the large focus. The following steps are possible: 20%, 35%, 50%, 65% and 80%. As a rule, the predefined APRs are programmed at 50%.

The percentage mix is not displayed direct on the control desk and can only be estimated indirectly via the small/large focus exposure time.

It is only possible to display and change the percentage mix via XRGSCOPE menu ***"Program/ Human Interface/ APR Data Set/Change APR Data Set"***. However, VARIOFOCUS can be selected via the control desk and can also be stored as default focus for an APR. The percentage mix is then always 50%.

VARIOFOCUS is only possible for tubes with superimposed focal spots.

The following tubes are suitable for the application: SRO 0950, SRO 2550, SRO 33100.

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16. Executing the acceptance test

- Execute the acceptance test according to section *"Acceptance"*.
- Observe all applicable national regulations.

For U.S.A.:

Checking H.H.S. requirements

After completition of setting–to–work, the system must be tested for H.H.S. compliance according the P.M.S.I. comprehensive compliance testing workbook (Code No. 4535 800 2035.).

17. Saving all configuration data

A hardware key is required of the PC.

- Store the configuration data on floppy disk "Generator configuration data" supplied in menu *"Accept/* ***Backup****"*.
  At the moment a backup is only possible for the APR programs of registration devices RGDV 1...8.
- We recommend saving the following programmings via the save function of the service program (F3 key):

– Mains Data	file:	md.dat
– Tube Limits		tl.dat
– Capacitance Tube Connection		ctc.dat
– Tube 1...3 Speed Selection		t#ss.dat
– RGDV 1...8/ Data Set A		rgdv#a.dat
– RGDV 1...8/ Data Set B		rgdv#b.dat
– Device Interface 1...2		di#.dat
– Dose Rate Control/ Chamber 1...5/ Data Set 1...5 (manual mode)		drc##.dat

- Provide the floppy disk with the serial number of the generator.
- Keep the floppy disk in the service documentation.

18. Labels

- Check the labelling according to the respective generator type.

See drawing 2Z–1.

The data labels of the generator are arranged on an information carrier which is located on the left–hand side of the upper edge of the cabinet. This information carrier is labelled "i".

19. Final installation work

- Mount the side panels of the generator cabinet.
- Roll the generator cabinet against the wall.
  Take care that all cables inside the wall junction box are routed in a loop without any kinks.
- Block the two front wheels of the cabinet with the locking screws to guarantee that unauthorized persons cannot accidentally touch parts of the generator which might be dangerous.
- If necessary, level the cabinet with the locking screws.
- Mount the front cover of the generator.

■

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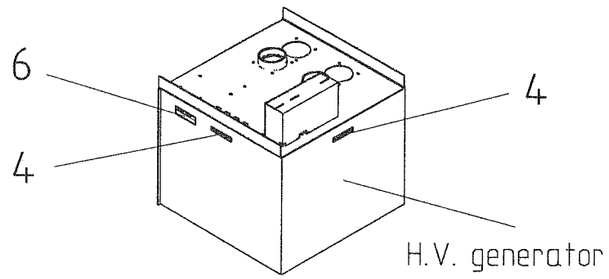

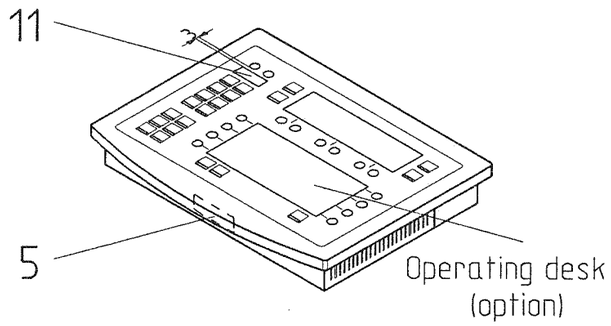

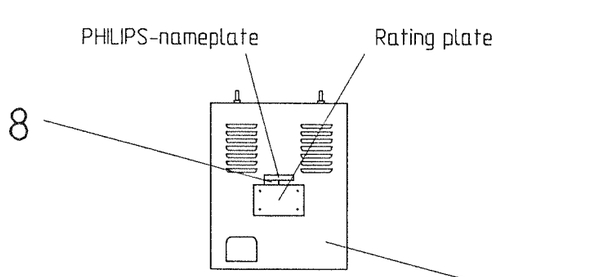

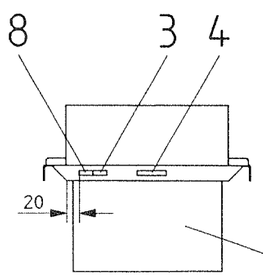

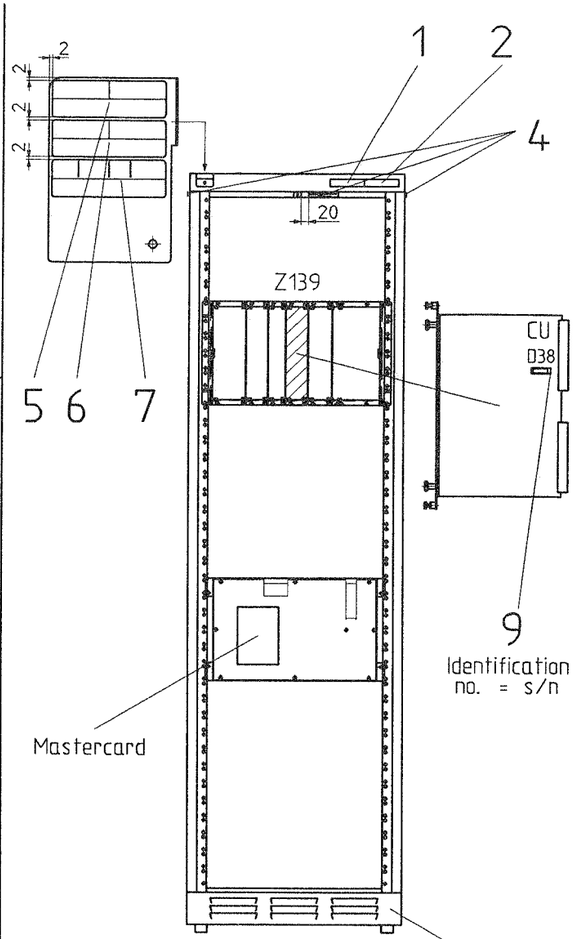

1 **OPTIMUS 50**

1 **OPTIMUS 65**

1 **OPTIMUS 80**

1 **OPTIMUS 100**

2 PHILIPS
MADE IN GERMANY

3
Philips Medizin Systeme
Röntgenstrasse 24
22335 Hamburg
Germany

4 CAUTION
HAZARD FOR LIVE AND/OR MOVING PARTS.
ATTENTION WHEN SERVICING ENERGIZED EQUIPMENT.
OBSERVE THE SERVICE-MANUAL.

5

-X-RAY CONTROL-	Philips Medizin Systeme
type 9890 000 0200x	Röntgenstrasse 24
s/n xx xxxx	22335 Hamburg
OPTIMUS xxx	Germany

6

-X-RAY HV GENERATOR-	Philips Medizin Systeme
type 9890 000 0200x	Röntgenstrasse 24
s/n xx xxxx	22335 Hamburg
OPTIMUS xxx	Germany

7 50 KW

3~ 50/60 HZ			
400V		5A	145 A
480V		4A	120 A

7 65 KW

3~ 50/60 HZ			
400V		5A	190A
480V		4A	160A

7 80 KW

3~ 50/60 HZ			
400V		5A	230A
480V		4A	190A

7 100 KW

3~ 50/60 HZ			
400V		5A	260A
480V		4A	220A

8
type Produktname
s/n Fabr. Nr.
code Code Nr.

9 SN.

Regulation- dependant labels

5

-X-RAY CONTROL-	Philips Medizin Systeme
type Produktname	Röntgenstrasse 24
s/n Fabr. Nr.	22335 Hamburg
code CI-Nr. oder PEI-Nr.	Germany

CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT JAHR

HHS

6

-X-RAY HV GENERATOR-	Philips Medizin Systeme
type Produktname	Röntgenstrasse 24
s/n Fabr. Nr.	22335 Hamburg
code CI-Nr. oder PEI-Nr.	Germany

CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT JAHR

HHS

7 50 KW

3~ 50/60 HZ			
400V		5A	145 A
480V		4A	120 A

- X-RAY EQUIPMENT -
CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY
641B
LR 37323 C

UL CSA

7 65 KW

3~ 50/60 HZ			
400V		5A	190A
480V		4A	160A

- X-RAY EQUIPMENT -
CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY
641B
LR 37323 C

UL CSA

7 80 KW

3~ 50/60 HZ			
400V		5A	230A
480V		4A	190A

- X-RAY EQUIPMENT -
CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY
641B
LR 37323 C

UL CSA

7 100 KW

3~ 50/60 HZ			
400V		5A	260A
480V		4A	220A

- X-RAY EQUIPMENT -
CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY
641B
LR 37323 C

UL CSA

11 **WARNING:**
THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT AND OPERATOR UNLESS SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED.
HHS

A3/A3 94-10-13 Ost.
v00328

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FAULT FINDING
RELEASE 1

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DRAWINGS

Central rack, service aid	3Z–1

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1. Tools

- Service engineer mechanical tool kit
- mAs meter
- Multimeter
- Digital oscilloscope with 2–beam memory
- PC incl. 3.5" FDD, HW–dongle, serial interface cable, free RAM ≥ 590 KB
- Service software "XRG SCOPE" 4512 152 04754

2. Notes

Caution!
After the generator has been switched off, hazardous voltages are still applied to the d.c. intermediate circuits of the converter and the rotor control.
These voltages are usually discharged within 1 minute to values which are no longer dangerous.

3. Strategy

There are 3 categories of errors:

- The generator cannot be switched on at all or only for a short time.
  See ⇒ 5. "Initialization phase of the generator"
  ⇒ 6. "Switch–on not possible"
- The generator can be switched on but no error numbers are displayed on the operating desk.
  For fault finding use the service PC.
  See ⇒ 4. "Connecting the service PC"
  ⇒ 5. "Initialization phase of the generator"
  ⇒ 7. "Error numbers"
- Error messages are displayed on the desk.
  For fault finding use the service PC.
  See ⇒ 4. "Connecting the service PC"
  ⇒ 7. "Error numbers"

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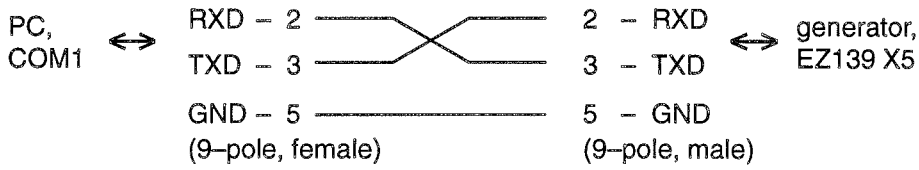
4. Service–PC

4.1. Connection

- Switch the generator on.
- Provide the PC with the HW key and switch it on.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable.



4.2. Operation

- Insert the floppy disk with the service program in the PC.
- Call the program with ***xrgscope*** *or with* ***xrgscope lcd*** *for PC's with LCD screen.*
- Enter you password
  The following menu line appears:

  File ***OPTIMUS*** ***Select Unit*** ***Options*** ***Help***

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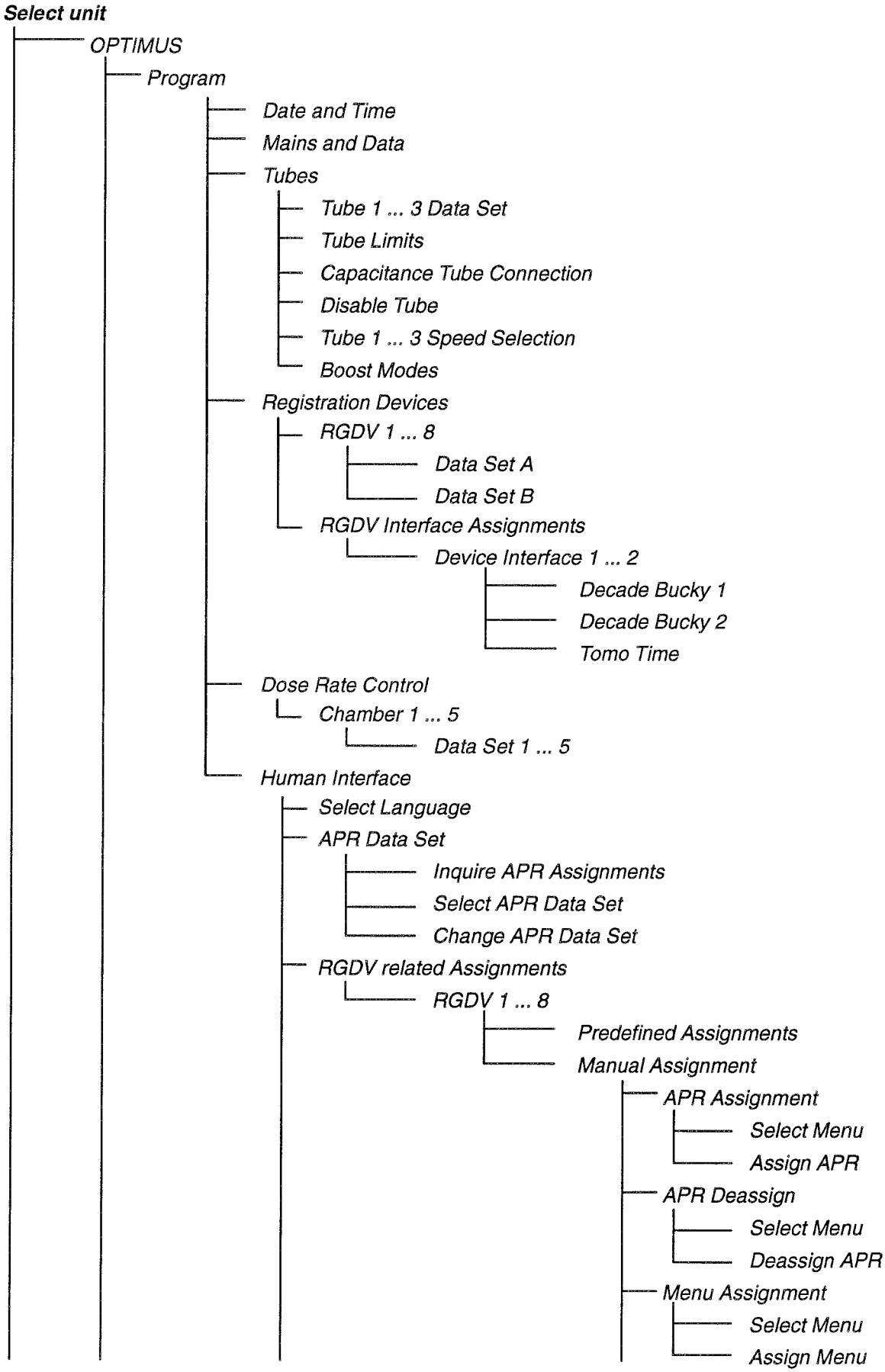
4.3. Menu structure



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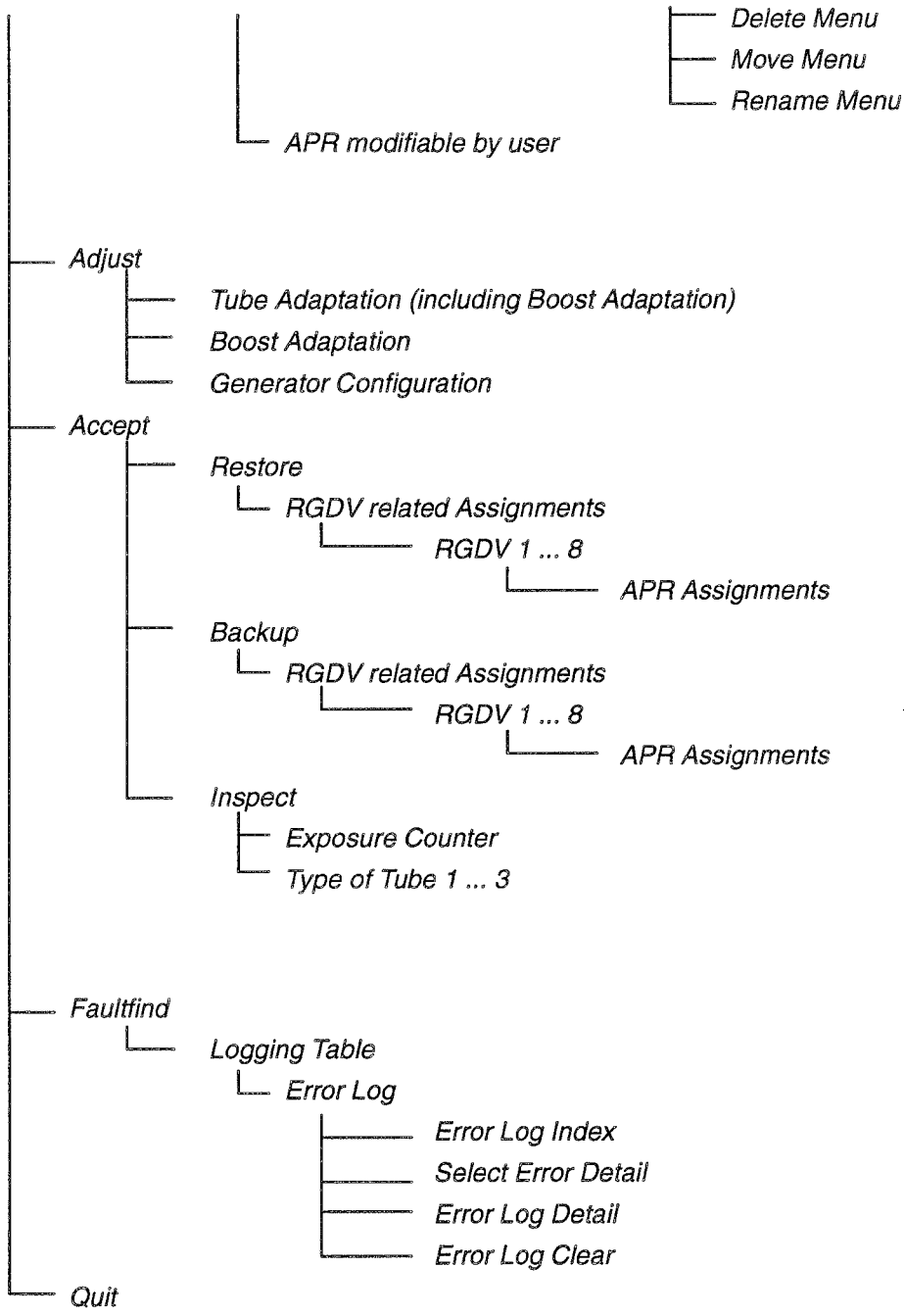

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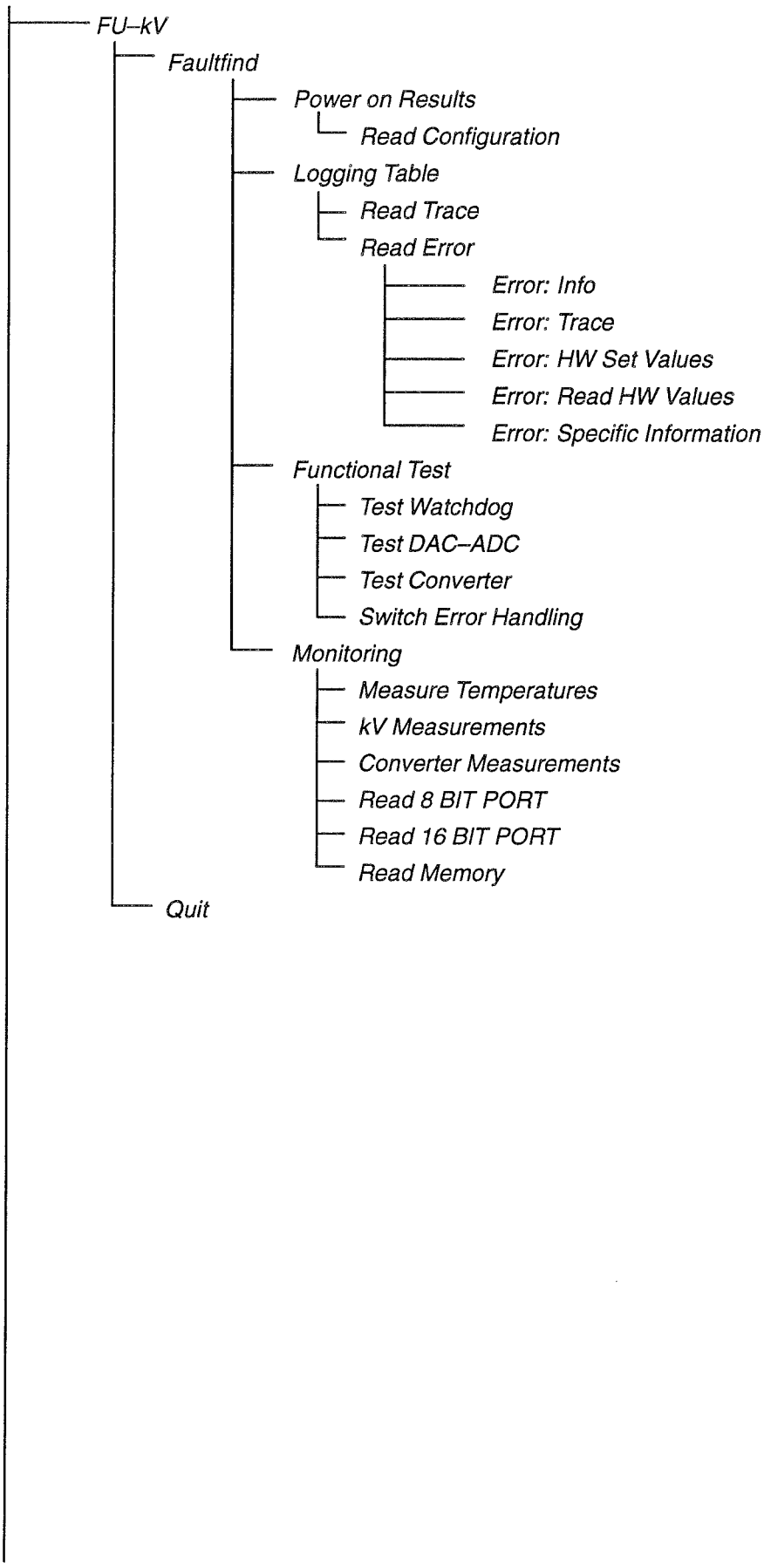

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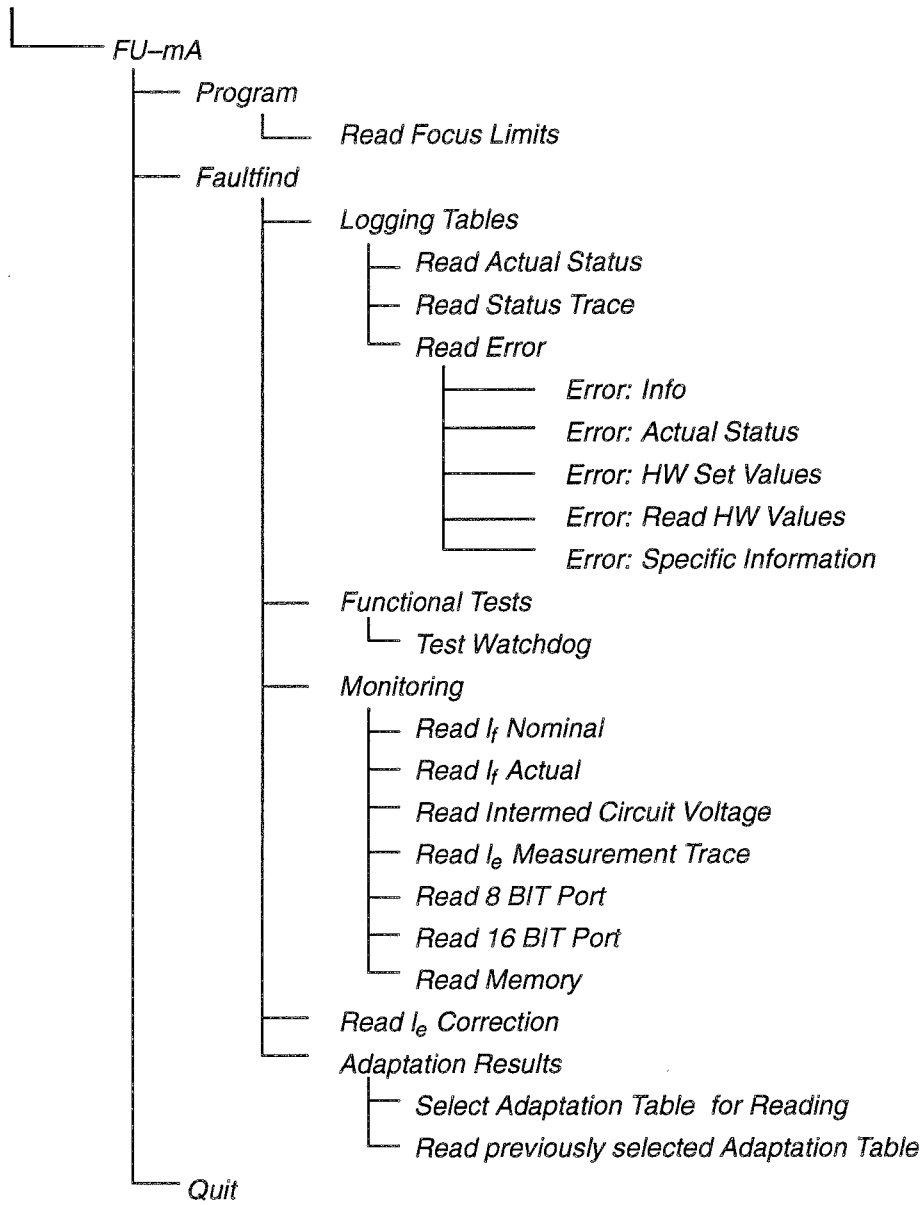

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4.4. Saving data on disk and restoring data

All configurations data and logging tables are stored in battery–buffered CMOS areas.

Therefore, these data should be saved on disk as a backup.

In case data get lost they can easily be restored in the CMOS areas after the error source has been eliminated.

Notes

- *It is not possible to save the adaptation data of the tubes connected as a backup. Therefore the tubes must be adapted again after the data has been restored.*
- *At the moment a backup is only possible for the APR programs of registration devices RGDV 1...8.*

Saving of data:

- Select menu ***"Accept/ Backup"***.
- Store the data on floppy disk "Generator configuration data" found in the service documentation.

Restoring of data:

- Select menu ***"Accept/ Restore"***.
- Restore the data from floppy disk.
- Adapt again the tubes connected with menu ***"Adjust/ Tube Adaptation"***.

Most of the other programmings and logging tables can be stored via the SAVE–function (button F3) of XRG SCOPE.

Some programmings can be restored via the LOAD–function (button F4).

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5. Initialization phase of the generator

Switch–on of the generator

|

Pulling–up of ENK 2

|

Selftest of ...

|... control desk C: All display elements are switched on for a short moment.

|... central unit EZ139: The computer boots within about ..... s.

|... kV control EZ130: voltage E is measured in the d.c. intermediate circuit.

|

|... mA control EZ119:

|... basic interface EZ150:

|... rotor control EY:

|

| Indicating device: The red status LED of the associated printed–circuit board or assembly is illuminated.

|

|

When the selftests have successfully been completed, the status LED's are blinking.

|

The central unit establishes connection to each functional unit via the CAN bus.

|

| Indicating device: The red status LED of the associated printed–circuit board or assembly grows dark.

|

ENK1 is switched on.

|

The generator is internally ready.

|

The external ready circuits are checked (unit ready, door contact closed, thermal contact of the tube closed, tube not overloaded).

|

The green READY lamp in the operating desk is illuminated.

The generator is in the READY state.

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6. Switch–on not possible

See drawings: Z1–2.1 / 2.2 / 2.3

Z2–2

H1 on PCB EN100 is not illuminated.

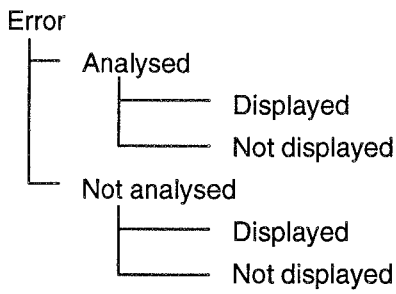
Error sources:
- ENF1 was released.
  For fault–finding look in the error buffer.
- ENF1 is not switched on.
- Mains voltage, especially phase L3, is not present.
- ENF2 was released.
  Check: Low–voltage supply
  Filament circuit
  Tube extension
  Rotor control
  External current consumers
- ENF2 is not switched on.
- PCB EN100 or its connections are not okay.

H1 on PCB EN100 is illuminated.

Error sources:
- The EMERGENCY–OFF circuit is open.
- The operating desk is not connected.

7. Error numbers

7.1. Error classification



Errors are displayed in a code consisting of 4 characters.

Analysed errors:

- These errors are indicated by 4 digits.
- The first two digits indicate the functional unit FU reporting the error.
  00xx = CU–functional unit is concerned
  02xx = kV–functional unit is concerned
  03xx = mA–functional unit is concerned
  etc.
- The last two digits indicate the assembly which is defective.

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Not analyzed errors:

- These errors are indicated by 2 digits and 2 letters.
- The first two digits indicate the functional unit reporting the error.
- The last two letters indicate the error symptom.

Displayed errors:

- These errors are indicated on the display of the operating desk for the customer.
- The customer must call the service.

  The customer can inform the service about the respective error number and the service can order the spare parts needed at an early stage of the maintenance procedure.

Not displayed errors:

- These errors are not relevant for the customer.
- In case an error of this category occurs frequently within a certain period of time, a displayed error can be generated.

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7.2. Error list

Sources of error codes indicated in the first two digits:

00=CU	01=FU_DRC	02=FU_kV	03=FU_mA_a	04=FU_mA_b	05=FU_mA_c
06=FU_mA_d	07=FU_CIE	08=FU_HI_a	09=FU_HI_b	10=FU_RC_a	11=FU_RC_b
12=FU_RC_c	13=FU_ADAP_a	14=FU_ADAP_b	15=FU_ADAP_c	16=FU_ADAP_d	17=FU_MDO
18=FU_ANA					

Class: Fatal error, Error, Warning

Error	class	explanation
00B0		error in service user interface
00B1		IIM was not expected by gen_order_list (IIM = internal interface message)
00B2		HI order is not expected – NO member in display_tab
00B3		NVRAM: data language selector invalid
00B4		ADopmes: required message is not valid
00B5		ADsynta: input parameter out of range
00B6		NVRAM: FU adap data for DI are invalid
00B7		Message cannot be send
00BA		NVRAM: data of RGDV are invalid
00BB		NVRAM: basedata of RGU are invalid
00BC		NVRAM: statedata of RGU are invalid
00BD		NVRAM: data of APR are invalid
00BE		NVRAM: data of active RGU are invalid
00BF		NVRAM: data of RGKeys are invalid
00BG		no more APR menus available
00BH		display position collision
00BI		invalid sublayer type for operation
00BJ		menu name not found
00BK		APR is assigned to a different RGU
00BL		menu name already exists
00BM		max display position reached
00BN		APR not found in this menu
00BO		NVRAM: data of menu tree are invalid
00BP		APR is active
00BQ		APR cannot be modified
00BR		APR is not assigned to an RGU
00BS		The RGU of the APR is not ready for operation
00BT		NVRAM: data of APR characteristics are invalid

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Error	class	explanation
00BU		adaptation paused due to missing load
00BV		TTS without power factor change while adaptation active
00CA		–
00CB		received IIM has invalid number
00CC		domain rx: frame–repeat–counter overflow
00CE		domain rx: signal conflict
00CF		domain tx: timeout (no retry from receiver)
00CG		domain tx: response mailbox type wrong
00CH		invalid tbdor parameter FU type
00CI		no FU acknowledges on CAN bus
00CJ		CAN successful configured
00CK		CAN configuration unsuccessful
00CQ		bucky is not responding
00CX		domain rx: last–only–rep–counter overflow
00CY		–
00CZ		–
00DA		no CPU access to CAN controller
00DB		CAN chip reset not acknowledged
00DD		check of DPRAM failed
00DE		unexpected value in CAN chip interrupt pointer register
00DF		CAN chip state undefined
00DG		CAN chip error active after passive
00DH		CAN chip state error passive
00DI		CAN chip state bus off
00DJ		CAN chip state DPRAM error
00DK		CAN chip state DPRAM error and passive
00Ex		something went wrong
00G0		variable in case statement has undefined value
00G1		condition code < > OK after CALL to send
00G2		condition code < > OK after CALL to init
00Hx		something went wrong
00I0		test error
00I1		index to I/O–table is wrong
00I2		no interrupt reason on signal bus
00I3		no interrupt reason on XS–bus

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Error	class	explanation
00I4		one FU has a watchdog error
00Kx		something went wrong
00L1		GC: checksum error
00L2		GC: data access error
00L3		GC: limit data error
00L4		GC: limits inconsistent
00L5		GC: calculation error
00L6		GC: function not implemented
00M0		unable to initialize one or more of the FUs
00M1		there is something wrong with the key
00M2		unable to initialize the FU mA
00Mx		something went wrong
00Ox		something went wrong
00PA	W	IIM/MSC number unknown
00PB	W	technic mode unknown
00PC	W	value limit overflow
00PD	E	unknown TDL proc ID
00PE	W	DRC NV checksum error
00S?		unexpected error
00SA		no space at destination segment
00SB		base out of range
00SC		value too large
00SD		terminator not found
00SE		error in description
00SF		item type unknown
00SG		internal type unknown
00SH		value negative
00SI		no space at destination buffer
00SJ		syntax wrong
00SK		string too long
00SL		string truncated
00SM		TDL segment overflow
00SN		FU reference table overflow
00SO		node ID unknown
00SP		FU code unknown

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Error	class	explanation
00SQ		syntax error in node ID
00SR		no node ID found
00SS		request not performed
00ST		RMX error
00SU		alt not found
00SV		mail corrupted
00SW		proc ID unknown
00SX		FU mA incompatible
00SY		FU Off request failed
00SZ		wrong response
00T?		unexpected error
00TA		message unknown
00TB		data status error
00TC		internal TTS error
00TD		tube number unknown
00TE		NVRAM: checksum error
00TF		NVRAM: unavailable
00Tx		something went wrong
00Ux		something went wrong
00X0		wrong timer ID
00X1		wrong timer mode
00X2		wrong message type
00X3		DWORD does not fit into BYTE3
00X4		timeout of X–ray backup timer – If syncmaster programmed: No response of bucky grid contact. – If multiple exposure programmed but no option (e.g. cine) present.
00X5		timeout of X–ray rotation timer
00X6		timeout setting FUs timer
00X7		curve token is NO TOKEN
00XA		NVRAM: switch table invalid
00XB		NVRAM: tube data rotation invalid
00XC		NVRAM: watch dog invalid
00XD		NVRAM: configuration table invalid
00XE		NVRAM: test data invalid
00XF		NVRAM: Rotor Control data invalid
00XG		received IIM is unknown

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Error	class	explanation
00XH		received FU type is unknown
00XI		init with FU–RoCo not OK
00XJ		exposure time too short
00XK		FU mA refuses set data
02AB	W	procedure called with wrong parameter
02AC	E	wrong index for table access
02AD	E	wrong do case entry
02AE	W	unknown IIM received
02AF	W	IIM parameter out of range
02EA	F	interrupt 0: divide by zero
02EB	F	interrupt 1: single step
02EC	F	interrupt 2: NMI; CAN connection lost
02ED	F	interrupt 3: breakpoint
02EE	F	interrupt 4: overflow exception
02EF	F	interrupt 5: array bounds exception
02EG	F	interrupt 6: unused opcode
02EH	F	interrupt 7: ESC opcode
02EI	F	CAN connection to CU lost; during warm reset only
02GA	W	interpolation of nominal values not possible
02HA	W	kV nominal value out of range: ± (4 % + 1 kV); 3 detections within 30 ms
02HB	E	kV nominal value out of range: 0 kV > U > 170 kV
02HC	W	Z (duty cycle) nominal value out of range: ± 1 % ± 0.2; 3 detections within 30 ms; duty cycle range 3 %...30 %
02HD	E	Z nominal value out of range: 0 % > Z > 50 %
02HE	W	kV value during standby too large: > 3 kV for > 400 ms after PREP
02HF	E	kV value during standby too large: > 4 kV for > 400 ms after PREP
02HG	W	kV actual value out of range: ± (4 % + 1 kV); 2 detections within 20 ms
02HH	E	kV actual value out of range: 20 kV > U > 170 kV; 3 detections within 30 ms
02HI	W	E value during standby out of range: 470 V > E > 780 V; 3 detections within 30 ms
02HJ	E	E value during standby out of range: 450 V > E > 800 V; 3 detections within 30 ms
02HK	W	E value during high tension out of range: 400 V > E > 780 V; 3 detections within 30 ms
02HL	E	E value during high tension out of range: 350 V > E > 800 V; 3 detections within 30 ms
02HM	W	converter 1 temperature out of range: 0 °C > T > 85 °C; 3 detections within 30 ms
02HN	E	converter 1 temperature out of range: 0 °C > T > 90 °C; 3 detections within 30 ms
02HO	W	converter 2 temperature out of range: 0 °C > T > 85 °C; 3 detections within 30 ms
02HP	E	converter 2 temperature out of range: 0 °C > T > 90 °C; 3 detections within 30 ms

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Error	class	explanation
02HQ	W	high tension tank temperature out of range: 0 °C > T > 80 °C; 3 detections within 30 ms
02HR	E	high tension tank temperature out of range: 0 °C > T > 85 °C; 3 detections within 30 ms
02HS	W	divider test cathode out of range: 45.5 kV > U > 50.5 kV; 3 detections within 30 ms
02HT	E	divider test cathode out of range: 43 kV ≥ U > 53 kV; 3 detections within 30 ms
02HU	W	divider test anode out of range: 45.5 kV > U > 50.5 kV; 3 detections within 30 ms
02HV	E	divider test anode out of range: 43 kV ≥ U > 53 kV; 3 detections within 30 ms
02HW	W	kV anode out of range, asymmetric ?: ± 15%; 2 detections within 20 ms
02HX	E	kV anode out of range, asymmetric ?: ± 15%; 3 detections within 30 ms
02MA	E	state request grid mode mismatch
02MB	E	state request not accepted because of kV error state
02MC	W	state requested unknown
02OA	F	RMX error: timeout
02OB	F	RMX error: memory
02OC	F	RMX error: busy
02OE	F	RMX error: limit
02OF	F	RMX error: context
02OG	F	RMX error: exist
02OH	F	RMX error: state
02OI	F	RMX error: not configured
02OJ	F	RMX error: interrupt saturation
02OK	F	RMX error: interrupt overflow
02OL	F	RMX error: transmission
02OM	F	RMX error: divide by zero
02ON	F	RMX error: overflow
02OO	F	RMX error: type
02OP	F	RMX error: parameter
02OQ	F	RMX error: bad call
02OR	F	RMX error: array bound
02OS	F	RMX error: NDP error
02OT	F	RMX error: illegal opcode
02OU	F	RMX error: emulator trap
02OV	F	RMX error: interrupt table limit
02OW	F	RMX error: CPU xfer data limit
02OX	F	RMX error: wrap around
02OY	F	RMX error: check exception

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Error	class	explanation
02OZ	F	RMX error: unknown
02RA	W	grid mode changeover requested during prep
02RB	W	tube switch requested during preparation
02RC	W	requested power out of range
02S?		unknown action requested; may happen during PC login
02SA	W	not enough space at destination
02SB	W	base out of range
02SC	W	value too large
02SD	W	terminator not found
02SE	W	terminator not found or description too long
02SF	W	item type not known
02SG	W	internal type definition not known
02SH	W	value is negative, absolute value only used
02SI	W	not enough space at the destination buffer
02SJ	W	syntax wrong or expression too long
02SK	W	string too long
02SL	W	string truncated
02SO	W	unknown table ID received
02SP	W	access level too low
02SQ	W	unknown action requested; may happen during PC login
02SR	W	routing info present or message corrupt
02SS	W	source buffer too small for incoming message
02ST	W	CAN buffer too small for outgoing message
02SU	W	requested action not available
02UA	E	HW configuration identifier wrong
02UB	W	Set Up request received during preparation
02WA	W	wrong tube selected
02WB	E	wrong tube selected
02WC	W	EN_X_C signal faulty; signal bus signal and CAN message not equal
02WD	E	EN_X_C signal faulty
02WE	W	wrong grid mode selected
02WF	E	wrong grid mode selected
02WG	W	tube arcing detected
02WH	E	tube arcing detected
02WI	W	kV over voltage detected: > 83 kV anode or cathode; 3 detections within 30 ms

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Error	class	explanation
02WJ	E	kV over voltage detected: > 83 kV anode or cathode
03AA	W	internal parameter error
03AB	W	wrong task parameter from CU
03AC	W	I_e regulation active on two filament circuits; only in case of VARIOFOCUS
03AI	W	wrong message sent to a certain mailbox
03BA	W	boost adaptation error; coordinates not monotonous
03BB	W	boost adaptation error; not enough measurement values for adaptation
03EA	F	CPU interrupt 0
03EB	F	CPU interrupt 1
03EC	F	CPU interrupt 2
03ED	F	CPU interrupt 3
03EE	F	CPU interrupt 4
03EF	F	CPU interrupt 5
03EG	F	CPU interrupt 6
03EH	F	CPU interrupt 7
03EI	F	CAN is unable to send an error info to CU; during warm reset only
03FA	W	checksum does not match a table in the NVRAM sector
03FB	W	standby filament current not found in the NVRAM table
03FC	F	no NVRAM found or plugged in
03FD	W	NVRAM empty; battery?
03GA	W	linear interpolation procedure failure
03GB	W	real underflow
03GC	W	real overflow
03GD	W	dword overflow
03GE	W	integer overflow
03GF	W	word overflow
03GG	W	wrong matrix seen during interpolation; adaptation cannot be completed
03HA	F	software FU_mA does not recognize hardware
03HB	E/W	intermediate circuit voltage too low: ≤ 200 V DC
03HF	W	undefined analog input channel selected
03IA	W	adaptation can not be completed
03IC	W	no measured values at the end of the I_e adaptation
03ID	W	during adaptation focus cannot be calculated with the data measured
03KA	W	conditional X–ray mode activated without mAs parameter
03MA	W	internal synchronization error during status change

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Error	class	explanation
03MB	W	status change not allowed
03MC	W	initialization data for FU–mA ignored
03OA	F	RMX exception:E$TIME
03OB	F	RMX exception:E$MEM
03OC	F	RMX exception:E$BUSY
03OD	F	RMX exception:E$LIMIT
03OE	F	RMX exception:E$CONTEXT
03OF	F	RMX exception:E$EXIST
03OG	F	RMX exception:E$STATE
03OH	F	RMX exception:ENOTCONFIGURED
03OI	F	RMX exception:EINTSATURATION
03OJ	F	RMX exception:EINTOVERFLOW
03OK	F	RMX exception:E$TRANSMISSION
03OL	F	RMX exception:E$ZERO$DIVED
03OM	F	RMX exception:E$OVERFLOW
03ON	F	RMX exception:E$TYPE
03OO	F	RMX exception:E$PARAM
03OP	F	RMX exception:EBADCALL
03OQ	F	RMX exception:E$ARRAY$BOUND
03OR	F	RMX exception:ENDPERROR
03OS	F	RMX exception:E$ILLEGAL$OPCODE
03OT	F	RMX exception:E$EMULATOR$TRAP
03OU	F	RMX exception:EINTTABLE$LIMIT
03OV	F	RMX exception:E$CPUXFER$DATA$LIMIT
03OW	F	RMX exception:ESEGWRAP$AROUND
03OX	F	RMX exception:E$CHECK$EXCEPTION
03OY	F	unknown RMX exception
03PA	E	I_e zero measured
03PB	W	I_e out of tolerance: ± 10 % (I_e > 5 mA, exp. time ≤ 44 ms) or ± 3 % (I_e > 5 mA, exp. time > 44 ms)
03PC	E	I_e out of tolerance: ± 30 % (I_e > 5 mA, exp. time > 44 ms)
03PD	W	internal synchronization error; no I_e regulation
03PE	F	Emergency off! Grid not closed! Emission current measured with grid closed.
03SB	W	I_f actual value out of tolerance: ± 3 %
03SC	E	I_f setpoint too large
03SD	E	I_f actual value out of tolerance: ± 500 mA within 250 ms

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Error	class	explanation
03SE	F	I_f actual value out of tolerance: ± 1000 mA within 150 ms
03SF	W	I_f nominal value out of tolerance: ± 3 %
03SG	E	I_f nominal value out of tolerance: ± 500 mA within 250 ms
03SH	F	I_f nominal value out of tolerance: ± 1000 mA within 150 ms
03SI	F	desired I_f value set by CU but not retriggered within the specified time
03SJ		value too large; wrong XRGSCOPE version, PC problem
03SK		description not found or too long
03SL		item type not known
03SM		internal type definition not known
03SN		value is neg., absolute values only used
03SO		not enough space at the destination buffer
03SP		syntax wrong or expression too long
03SQ		string too long
03SR		string truncated
03SS		unknown action requested
03ST		routing info present or mess. corrupt
03SU		access level is not available
03SV		access level too low
03SW		unknown table ID received
07LA		CV WAR IIM unknown
07LB		Rotor Control stator number out of range
07LC		Rotor Control stator not available
07LD		Rotor Control stator 1 readback
07LE		Rotor Control stator 2 readback
07LF		Rotor Control stator 3 readback
07LG		Rotor Control speed value out of range or not programmed
07LH		acceleration timeout; no ready of low speed rotor control
07LI		stator loading too high after 4 accelerations within 1 minute
07LJ		Rotor Control max. rotation time exceeded
07LK		AMPLIMAT chamber number out of range
07LL		AMPLIMAT field number out of range
07LM		AMPLIMAT delay value out of range
07LN		door contact measuring path error
07LO		cooling unit contact measuring path error
08DC		APR not found

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Error	class	explanation
08DD		offset in menu structure out of range
08DH		APR buffer full
08IE		wrong setup IIM
08IF		no message request for test task
08IG		no message send for test task
08RA		no message received display task
08RB		no message receive display task
08SA		no request dom_txt_task when scanning
08SB		no request dom_txt_task when testing
08SC		no send message to task2 sc
13LA	W	IIM unknown
13LB	W	bidirectional value
13LC	W	tomo value out of range
13LD	W	RGDV value out of range
13LE	E	RGDV readback
13LF	W	sync. value out of range
13LG	W	handswitch value out of range
14LA	W	IIM unknown
14LB	W	bidirectional value
14LC	W	tomo value out of range
14LD	W	RGDV value out of range
14LE	E	RGDV readback
14LF	W	sync. value out of range
14LG	W	handswitch value out of range

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8. Converter test

See drawings: Z1–3.2 / 3.3

Z2–3

8.1. Hardware problems

An ENF1 tripout will be the 'message' if something serious happened in the converter. If something like this occurs, replace the whole kV power unit. We want to have the complete unit to get a chance of researching the problem.

- Before the ENF1 is pushed back to the on position check if all contacts of ENK1 1–2, 3–4 and 5–6 are open in the non–energized condition of the relay. If not, replace the relay before you switch on ENF1 and proceed with other test activities.

The first thing to look at will be the emitter–collector / emitter–gate impedance at every IGBT 1 to 4. If all 4 of a kV power unit are not 0 Ohms (50 kW) and none of the 8 of a double converter generator is on 0 Ohms one should not suspect the power unit(s) (so far).

Are there any damages on the driver PCB('s)?

- Check the snubber diodes V 500 / 501 / 502 / 503 for short-circuit. If one has a short–circuit some of the resistors linked to the damaged diode(s) must also be open or have some overheat characteristics.

The second step should be the measurement of the rectifier(s) EQV5 (E2QV5). It could have been damaged from overvoltage (surge). Look for short-circuits and, after the next switch–on, for error codes 02HI and/or 02HJ (E_value out of range = DC power supply) in the error log index.

02HI = 470 V > E_value > 780 V in standby ≥ 30 ms
02HJ = 450 V > E_value > 800 V –dto– .

- Remove the driver PCB('s) to look at the current tracks for short-circuit (insulation damaged?)
- Check all 4 DC capacitors for short-circuit. Are the DC symmetry resistors R1 + R11 ok (47 kΩ)?
- Are the frequency capacitors C3 and C13 ok?
- If everything seems to be fine so far reinstall the kV_driver PCB.
- Switch on ENF1.
- Switch on the generator.

With switch–on the converter DC supply will be charged via the dumping (spring) resistors EN R1, R2 and R3. If there is still any kind of short-circuit in the machine we could not measure with a (low voltage) Ω–meter and/or there is a part in the generator which fails when the AC or DC increases a certain level, one or two of the spring resistors might become very hot and will open.

If it does not happen, measure the converter DC supply at ENK2 41(+) and 42(–). It should have a value between 480 V and 750 V.

If the machine is in a stable standby condition, proceed with the converter driver test without converter DC supply.

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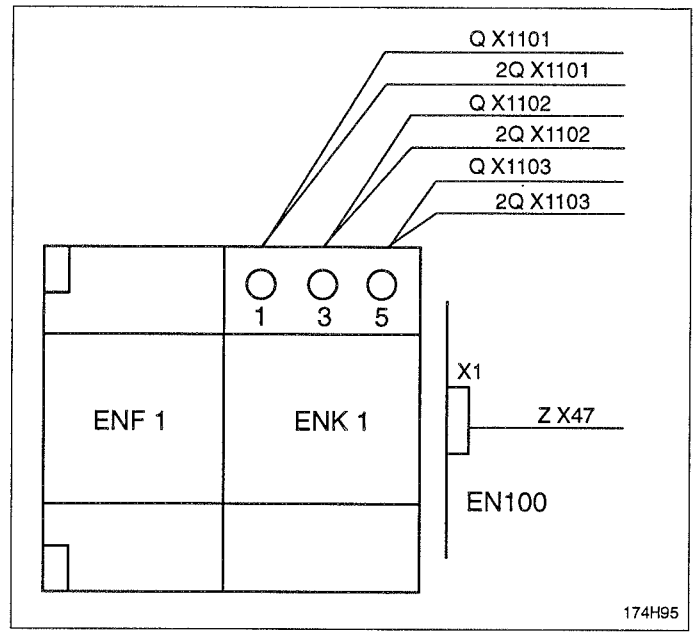
8.2. kV driver test

Caution!
Before this driver test can be carried out the kV power unit(s) must be disconnected from the mains supply (leads of unit(s) EQ/E2Q to ENK1 :1, :3, :5).

This safety measure is also valid for the chopper test to guarantee that the measurements can be carried out without any risks involved.



The kV driver test is software controlled via PC. Due to the missing PREP and exposure requests the signals **EN_X_C/** and **CTRL_X_C/** have to be set low–active at the backpanel at locations **X76** and **X74** (see drawing Z2–5.1/2).

Caution!
Do not forget to remove these connections after the test. Otherwise kV will start immediately with the PREP command in normal application mode.

- Switch on the generator.
  Ignore error codes 02HI and 02HJ now, the DC supply is off and these error must come up.
- Check whether the gate voltage is about –14.2 V ±0.3V against emitter for every IGBT.
- Check the ±15 V supply for the IGBT drivers now. Drivers 1 and 2 are supplied by chopper 1 while drivers 3 and 4 are supplied by chopper 2. The common zero point is the emitter.

Emitter	+15 V supply at heat sink	–15 V at resistor		
E1, X101	A100	R103 upper position	or	X102 (Q100 ≥ 4512 108 08621)
E2, X201	A200	R203 upper position		X202
E3, X301	A300	R303 lower position		X302
E4, X401	A400	R403 upper position		X402

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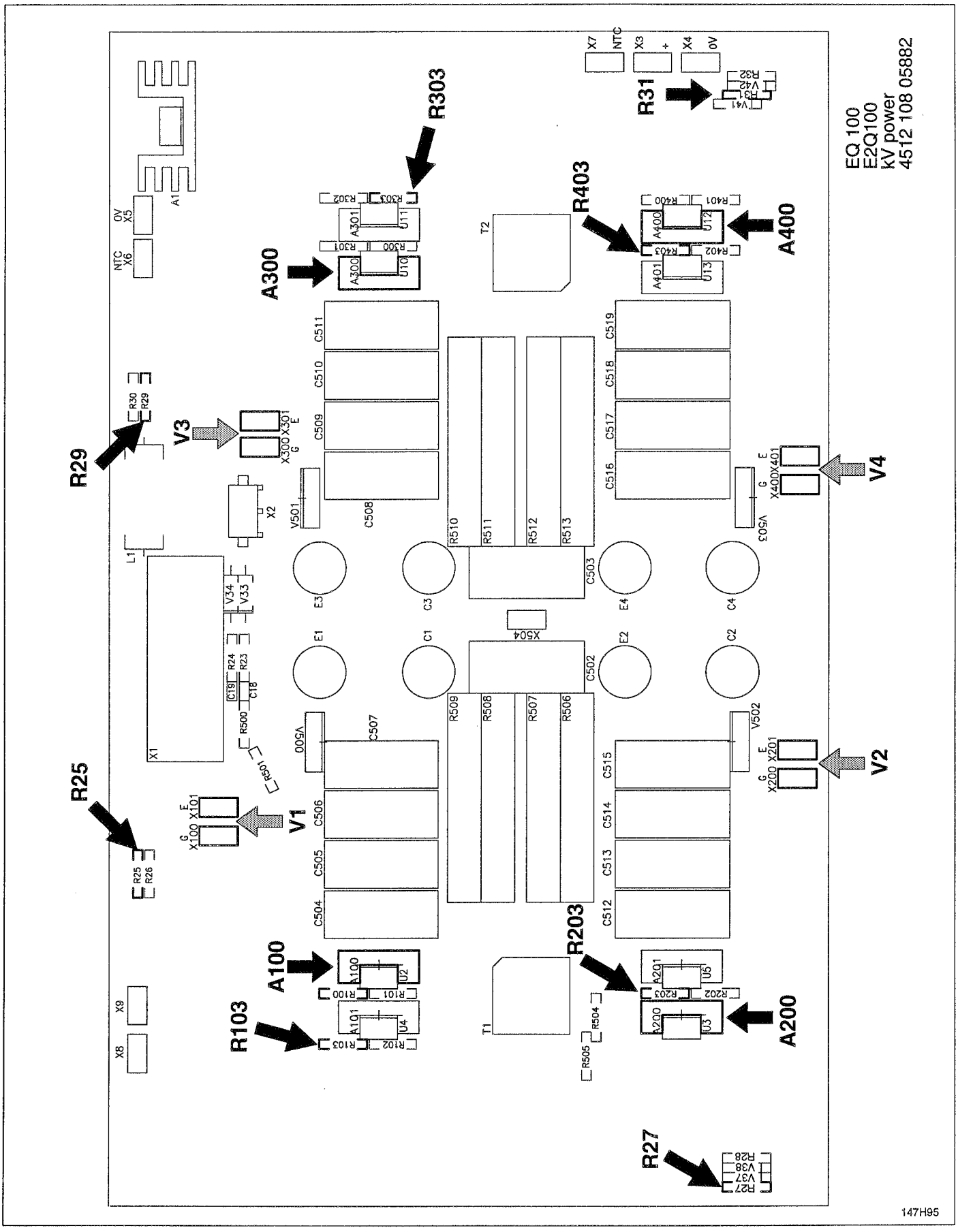

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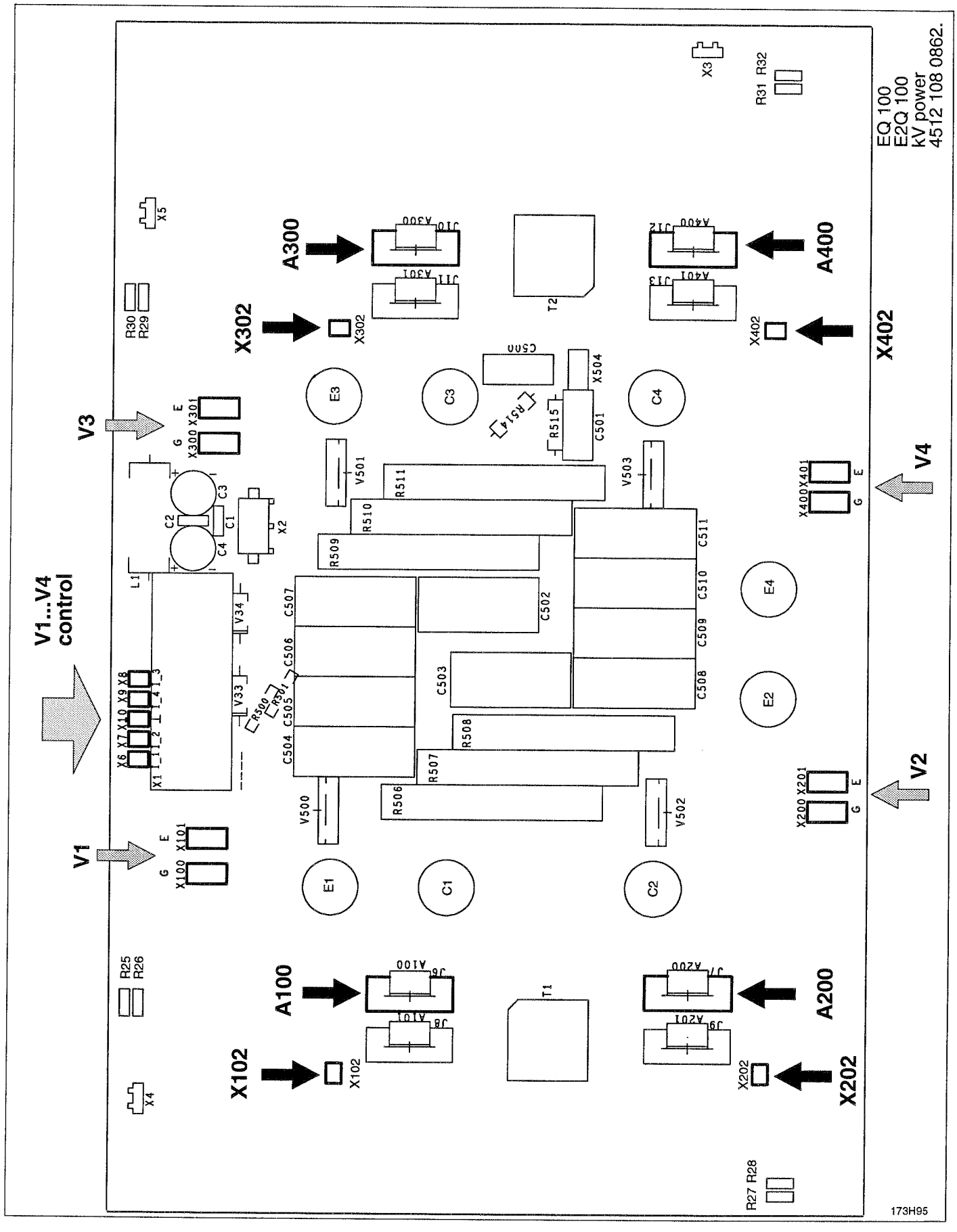

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Test of control signal(s) and driver(s) behaviour:

The range of the control signal is + 3.7 V ± 0.2 V for the on condition and + 1.2 V ± 0.2 V for the off condition at the specified measuring point against generator ground (see drawings of principals and PCB layout).
The range of the driver signal (gate against emitter) is – 14.2 V ± 0.3 V for the off condition and + 13.5 V ± 0.3 V for the on condition.

- Select menu ***"FU_kV/ Faultfind/ Functional Test/ Test Converter"*** at the service PC.
  The question **[power supply mains – E disconnected ?:]** will come up.
  Answer with 'yes' (type Return twice) and transmit with [F2].

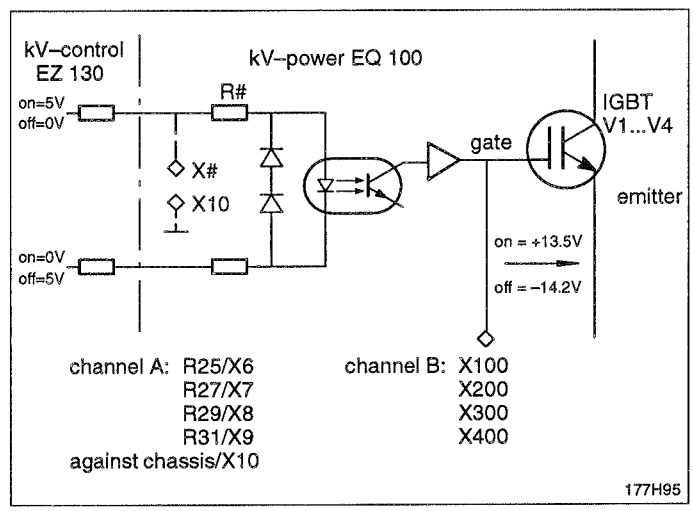
If the test takes longer than 10 minutes it may happen, that the test will be denied by the kV_control. This happens if the DC voltage = E–value increases 5 V (the DC capacitors are slowly charged by the ± 15 V of the drivers). Then short–circuit the DC at collector C1 and emitter E2.

Do not establish a constant short-circuit to avoid a big problem after the test!

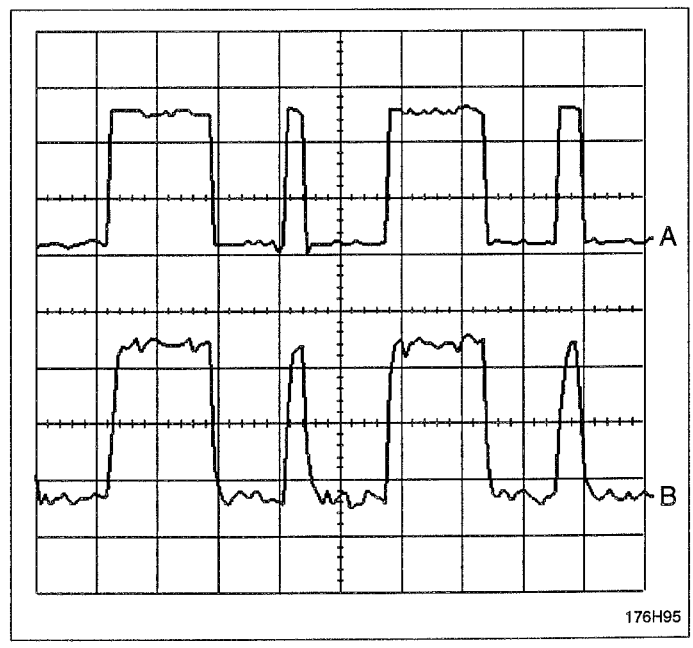
The test itself is short. The pulse time is 2.5 sec long, but the PC screen says **[completed]** after 5 seconds. kV_control sends pulses for 5 seconds, but the hardware timer on the kV_control inhibits more pulses after 2.5 ms. Within this time the actual kV have to be on the nominal value.

Test 1 : in– and output:

- Put a 2 beam scope to every measuring point of the control signals (channel A) and to every gate belonging to the inputs (channel B).
  Measuring points X6...X10 are present at the new kV power unit 4512 108 0862x only.
- Trigger with the negative slope of channel A, take 10..50µs/Div.



The 'needle' shape of the attached scope picture is due to the resolution of the scope, which has been magnified thereafter.



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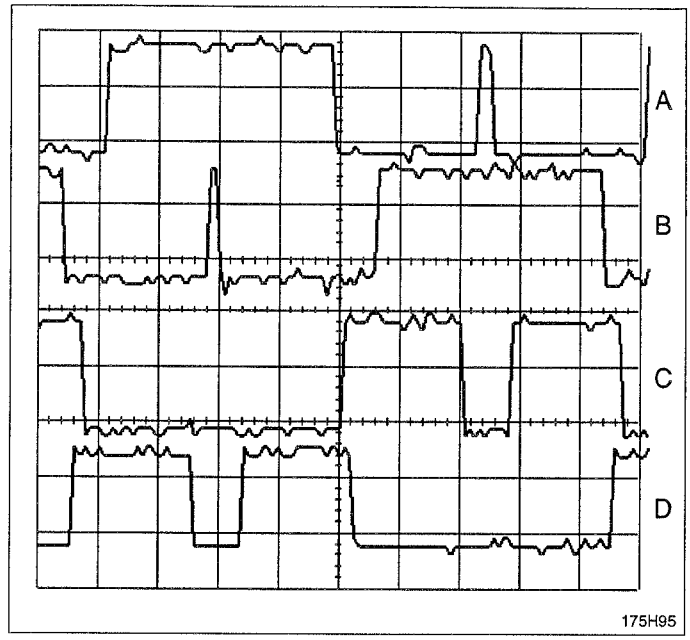
Test 2 : inputs only:

- Check if the signal pattern of all 4 control signals look the same as on the diagram. Of course, only 2 channels be seen at the same time, but the "on's" and "off's" **must** be equal to the drawing. There should **never** be an on (low active) of A (R25) + C (R27) and **never** be an on of B (R31) + D (R29).



Test 3 : only for 65/80/100kW with two kV power units:

- Compare control signals of both units.
  The signals at R25 of unit 1 must be absolutely equal to the signal at R25 at unit 2.

If no problems are visible = all waveforms are as they should be:

- Switch off the generator with **ENF1**.
- Remove links **EN_X_C/** and **CTRL_X_C/** at the backpanel **X76** and **X74**.
- Remove scope probes.
- Close the kV power part(s).
- Connect mains power lines at ENK1 :1 :3 :5.
- Switch on ENF1 and the generator.

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9. Mnemonic and routing list

Example:

MNEMONIC	explanation chain value measuring point trigger point remarks part of supply
AC_0V_XG	mains supply 0 V X–ray generator ENX1102–EZX13:2–EZ102X1:DBZ4–EZ119X1:DBZ24 EZX14:2– EZX15:2–EWRX21:2
AC_230V_L1	mains supply 230V AC phase 1 ENF3:L1–EZX13:1–EZX102X1:DBZ2 EZX14:1– EZX15:1–EWRX21:1–
AC_230V_L2	mains supply 230V AC phase 2 ENF3:L2–EZX13:3–EZ119X1:DBZ26
AV_HT_AN	high tension actual value anode side 0V...+3.75V 1V ≙ 20kV measuring point EZ130X4
AV_HT_CA	high tension actual value cathode side 0V...+3.75V 1V ≙ 20kV measuring point EZ130X5
AV_HT	high tension actual value 0...+7.5V 1V ≙ 20kV measuring point EZ130X3
CAN_H	generator CAN high active EZ119X2:C3–EZ130X2:C3–EZ139X2:C3–EZ150X2:C3–EZX44:10–EZX45:10–EZX46:10– –C300X1:10–EZX51:3–EZX151:3–EZX52:7–EZX72– EWAX51:10–EWAX52:10–EWA100X2:C3– 0V/5V measuring point EZX72 part of: XRG bus
CAN_L	generator CAN low active EZ119X2:A3–EZ130X2:A3–EZ139X2:A3–EZ150X2:A3–EZX44:2–EZX45:2–EZX46:2– –C300X1:2–EZX51:2–EZX151:2– EZX52:2–EZX71– EWAX51:2–EWAX52:2–EWA100X2:A3– 0V/5V measuring point EZX71 part of: XRG bus
CM_EX_SW_1	common for exposure switch of release decade 1 EWA100X1:C5–EWAX1:10–

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CM_EX_SW_2	common for exposure switch of release decade 2 EWA100X1:C7–EWAX2:10–
CM_EX_SW_3	common for exposure switch of release decade 3 EWA100X1:C9–EWAX3:10–
CM_EX_SW_4	common for exposure switch of release decade 4 EWA100X1:C11–EWAX4:10–
CM_SW	common for radiation indication EZ150X1:C29–EZX1:6–
CM_TH	common for thermal sensor of tube housing EZ130X1:C12–EZX3:7– (generator basis 4512 104 70202/70601 only) EZ130X1:C12–EZX3:4–
CM_TH_SW	common for tube housing switch EZ130X1:C11–EZX3:4– (generator basis 4512 104 70202/70601 only) EZ130X1:C11–EZX3:7–
CTRL_X/	control X–ray request command, system level EZ139X1:A4–EZX23:4–EZX45:5–EWAX51:5–EWAX52:5–EWA100X2:C25– 0V/15V measuring point: EZX85 part of: system signal bus
CTRL_X_C/	control X–ray request command, internal generator level EZ119X2:C6–EZ130X2:C6–EZ139X2:C6–EZ150X2:C6–EZX52:8– 0V/5V measuring point EZX74 driven by CU, active, if STOP_X_C/ not active, immediately inactive if STOP_X_C/ active, controls all non AEC exposures with exposure timer or AEC exposures with DRC timer HTON high tension on command (internal generator command) resp. 20/21 signal (external = old world) part of: XS/XRG bus
CU_CT1_1	cooling unit contact 1_1 EZ150X1:A22–EZX2:6–
CU_CT1_2	cooling unit contact 1_2 EZ150X1:C22–EZX2:7–
CV1_GND	converter power part 1 ground EZ130X1:AC8–EZX24:8/21–EQ100X1:8/21
CV1_GND_OL	converter power part 1 ground overload (generator basis ≥ 4512 104 70203/70602) EZ130X1:A7–EZX24:20–EQ100X1:20
CV1_ID/	converter power part 1 identification EQ100X1:19–EZX24:19–EZ130X1:A6– open 5V, low active 0V

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CV1_OL/	converter power part 1 overload EQ100X1:7–EZX24:7–EZ130X1:C7– open +26V, low active 0V
CV1_TM	converter power part 1 temperature EQ100X1:6–EZX24:6–EZ130X1:C6– 0.3...3.5V, 85 °C...0 °C
CV2_GND	converter power part 2 ground EZ130X1:AC29–EZX34:8/21–E2Q100X1:8/21
CV2_GND_OL	converter power part 2 ground overload (generator basis ≥ 4512 104 70203/70602) EZ130X1:A28–EZX34:20–E2Q100X1:20
CV2_ID/	converter power part 2 identification E2Q100X1:19–EZX34:19–EZ130X1:A27– open 5V, low active 0V
CV2_OL	converter power part 2 overload E2Q100X1:7–EZX34:7–EZ130X1:C28– open +26V, low active 0V
CV2_TM	converter power part 2 temperature EZ130X1:C27–E2Q100X1:6–EZX34:6– 0.3...3.5V, 85 °C...0 °C
DR_BV_0V	dose rate (signal) reference of image intensifier EZX61:3–EZ139X2:C18– negative potential of II unit, 0V ± 50mV against generator ground differential signal with DR_BV_SG part of: dose rate control
DR_BV_SG	dose rate signal of image intensifier EZX61:8–EZ139X2:A18– positive potential, 0...10V differential signal with DR_BV_0V part of: dose rate control
DR_FQ_NG	dose rate signal (pulses) negative EZX61:6–EZ139X2:C20– 0.1 µR / pulse optocoupled interface, dose rate signal = pulsed frequency part of: dose rate control
DR_FQ_PO	dose rate signal (pulses) positive EZX61:1–EZ139X2:A20– 0.1 µR / pulse optocoupled interface, dose rate signal = pulsed frequency part of: dose rate control

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DR_TV_NT	dose rate of TV chain signal negative, fluoro regulation EZX61:4–EZ139X2:C19– ±12V minus polarity dual voltage differential signal +12V = 200% light, 0V = 100% light, –12V = 50% light part of: dose rate control
DR_TV_PT	dose rate of TV chain signal positive, fluoro regulation EZX61:9–EZ139X2:A19– ±12V positive polarity dual voltage differential signal –12V = 200% light, 0V = 100% light, +12V = 50% light part of: dose rate control
DS_BV_0V	dose (signal ramp) reference of image intensifier EZX61:2–EZ139X2C17– negative potential of II unit, 0V ±50mV against generator ground differential signal with DS_BV_SG part of: dose rate control
DS_BV_SG	dose signal ramp of image intensifier signal EZX61:7–EZ139X2:A17– 0...10V, polarity positive differential signal with DS_BV_0V part of: dose rate control
DS_MC_0V	dose (signal ramp) reference of selected measuring chamber EZ150X2:C16–EZ139X2:C16 negative potential of selected measuring chamber, 0V ±50mV against generator ground differential signal with DS_MC_SG
DS_MC_SG	dose signal ramp of selected measuring chamber EZ150X2:A16–EZ139X2:A16– 0...12V differential signal with DS_MC_0V
E_NG_CV1/2	E value converter DC supply negative converter 1: EQ100X1:5–EZX24:5–EZ130X1:C5– converter 2: E2Q100X1:5–EZX34:5–EZ130X1:C26 (future releases) 0...–12V ≙ 0...–375V
E_PO_CV1/2	E value converter DC supply positive converter 1: EQ100X1:18–EZX24:18–EZ130X1:A5– converter 2: E2Q100X1:18–EZX34:18–EZ130X1:A26 (future releases) 0...+12V ≙ 0...+375V
EN_X/	enable X–ray, system level EZ139X1:C2–EZX10:1/3–EZX23:15–EZX45:11–EZX46:11–C300X1:11– –EWAX51:11–EWAX52:11–EWA100X2:C26– measuring point: EZX82, EZ139X9 part of: signal bus 0V/15V low active

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EN_X_C/	enable X-ray, internal generator level EZ119X2:C7–EZ130X1:A9–EZ130X1:A30–EZ130X2:C7–EZ139X2:C7–EZ150X2:C7–EZX52:9–EZX76– 0V/5V low active measuring point EZX76 driven by CU if EN_X/ active (low) part of: XS/XRG bus
CV1 EN/ CV2 EN/	converter 1/2 enable converter 1: EZ130X1:A9–EZX24:22–EQ100X1:22– converter 2: EZ130X1:A30–EZX34:22–E2Q100X1:22–
EX_ON	exposure on EWA100X2:A9–EWAX14:7– part of: exon old world
FD_C_CH1	central field measuring chamber 1 EZ150X1:C4–EZX21:12– 15V, R_i = 220 Ω
FD_C_CH2	central field measuring chamber 2 EZ150X1:A4–EZX22:12– 15V, R_i = 220 Ω
FD_C_CH3	central field measuring chamber 3 EZ150X1:C10–EZX31:12– 15V, R_i = 220 Ω
FD_C_CH4	central field measuring chamber 4 EZ150X1:A10–EZX32:12– 15V, R_i = 220 Ω
FD_C_CH5	central field measuring chamber 5 EZ150X1:C16–EZX41:12– 15V, R_i = 220 Ω
FD_L_CH1	left field measuring chamber 1 EZ150X1:C3–EZX21:11– 15V, R_i = 220 Ω
FD_L_CH2	left field measuring chamber 2 EZ150X1:A3–EZX22:11– 15V, R_i = 220 Ω
FD_L_CH3	left field measuring chamber 3 EZ150X1:C9–EZX31:11– 15V, R_i = 220 Ω
FD_L_CH4	left field measuring chamber 4 EZ150X1:A9–EZX32:11 15V, R_i = 220 Ω

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FD_L_CH5	left field measuring chamber 5 EZ150X1:C15–EZX41:11– 15V, R_i = 220 Ω
FD_R_CH1	right field measuring chamber 1 EZ150X1:C5–EZX21:3 15V, R_i = 220 Ω
FD_R_CH2	right field measuring chamber 2 EZ150X1:A5–EZX22:3– 15V, R_i = 220 Ω
FD_R_CH3	right field measuring chamber 3 EZ150X1:C11–EZX31:3– 15V, R_i = 220 Ω
FD_R_CH4	right field measuring chamber 4 EZ150X1:A11–EZX32:3– 15V, R_i = 220 Ω
FD_R_CH5	right field measuring chamber 5 EZ150X1:C17–EZX41:3– 15V, R_i = 220 Ω
FI_TF1_1	filament transformer 1 line 1 EZ119X1:DBZ4–EZX12:1–EG106X15:1– max. 300Veff or ± 150V against ground, 100...20kHz
FI_TF1_2	filament transformer 1 line 2 EZ119X1:DBZ6–EZX12:2–EG106X15:2– max 300Veff or ± 150V against ground, 100...20kHz
FI_TF2_1	filament transformer 2 line 1 EZ119X1:DBZ8–EZX12:4–EG106X15:4 max. 300Veff or ± 150V against ground, 100...20kHz
FI_TF2_2	filament transformer 2 line 2 EZ119X1:DBZ10–EZX12:5–EG106X15:5– max. 300Veff or ± 150V against ground, 100...20kHz
GND	
GND_15V	ground (+15V) for desk handswitch C300X3:1/2/6–
GNDC S_CAN_GND	CAN bus ground EZ139X1:C17–EZX42:3/6–EZX43:3/6–EZX44:9– part of: system CAN

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GNDS	signal bus ground
PO_0V	EZ139X1:AC1–EZX23:1/14–EZX44:15–EZX45:15–EWAX51:15–EWAX52:15– part of: signal bus negative
HT_AN	high tension anode side actual value EG100X14:2–EZX35:2–EZ130X1:C17– 0...+10V ≙ 0...+100 kV
HT_AN_GND	high tension anode side ground EG100X14:10–EZX35:10–EZ130X1:A17– 0V
HT_CA	high tension cathode side actual value EG100X14:1–EZX35:1–EZ130X1:C16– 0...–10V ≙ 0...–100kV
HT_CA_GND	high tension cathode side ground EG100X14:9–EZX35:9—EZ130X1:A16 0V
I1_1 I1_1/	IGBT1 power part 1 EQ100 = 4512 108 05882 IGBT1 power part 1 EQ100 ≥ 4512 108 08621 * EZ130X1:C1–EZX24:1–EQ100X1:1–
I1_1/ I1_1	IGBT1 power part 1 EQ100 = 4512 108 05882 IGBT1 power part 1 EQ100 ≥ 4512 108 08621 * EZ130X1:A1–EZX24:14–EQ100X1:14– value: on = 3.7V off = 1.2V against ground * = X10 measuring point EQ100 R25 end to X1 * EQ100 X6
I1_2 I1_2/	IGBT2 power part 1 EQ100 = 4512 108 05882 IGBT2 power part 1 EQ100 ≥ 4512 108 08621 * EZ130X1:C2–EZX24:2–EQ100X1:2–
I1_2/ I1_2	IGBT2 power part 1 EQ100 = 4512 108 05882 IGBT2 power part 1 EQ100 ≥ 4512 108 08621 * EZ130X1:A2–EZX24:15–EQ100X1:15– value: on = 3.7V off = 1.2V against ground * = X10 measuring point EQ100 R27 end to X1 * EQ100 X7
I1_3 I1_3/	IGBT3 power part 1 EQ100 = 4512 108 05882 IGBT3 power part 1 EQ100 ≥ 4512 108 08621 * EZ130X1:C3–EZX24:3–EQ100X1:3–
I1_3/ I1_3	IGBT3 power part 1 EQ100 = 4512 108 05882 IGBT3 power part 1 EQ100 ≥ 4512 108 08621 * EZ130X1:A3–EZX24:16–EQ100X1:16– value: on = 3.7V off = 1.2V against ground * = X10 measuring point EQ100 R29 end to X1 * EQ100 X8

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I1_4	IGBT4 power part 1 EQ100 = 4512 108 05882
I1_4/	IGBT4 power part 1 EQ100 ≥ 4512 108 08621 *
	EZ130X1:C4–EZX24:4–EQ100X1:4–

I1_4/	IGBT4 power part 1 EQ100 = 4512 108 05882
I1_4	IGBT4 power part 1 EQ100 ≥ 4512 108 08621 *
	EZ130X1:A4–EZX24:17–EQ100X1:17–
	value: on = 3.7V off = 1.2V against ground * = X10
	measuring point EQ100 R31 end to X1 * EQ100 X9

I2_1	IGBT1 power part 2 E2Q100 = 4512 108 05882
I2_1/	IGBT1 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:C22–EZX34:1–E2Q100X1:1–

I2_1/	IGBT1 power part 2 E2Q100 = 4512 108 05882
I2_1	IGBT1 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:A22–EZX34:14–E2Q100X1:14
	value: on = 3.7V off = 1.2V against ground * = X10
	measuring point EQ100 R25 end to X1 * E2Q100 X6

I2_2	IGBT2 power part 2 E2Q100 = 4512 108 05882
I2_2/	IGBT2 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:C23–EZX34:2–E2Q100X1:2–

I2_2/	IGBT2 power part 2 E2Q100 = 4512 108 05882
I2_2	IGBT2 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:A23–EZX34:15–E2Q100X1:15–
	value: on = 3.7V off = 1.2V against ground * = X10
	measuring point EQ100 R27 end to X1 * E2Q100 X7

I2_3	IGBT3 power part 2 E2Q100 = 4512 108 05882
I2_3/	IGBT3 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:C24–EZX34:3–E2Q100X1:3–

I2_3/	IGBT3 power part 2 E2Q100 = 4512 108 05882
I2_3	IGBT3 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:A24–EZX34:16–E2Q100X1:16–
	value: on = 3.7V off = 1.2V against ground * = X10
	measuring point EQ100 R29 end to X1 * E2Q100 X8

I2_4	IGBT4 power part 2 E2Q100 = 4512 108 05882
I2_4/	IGBT4 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:C25–EZX34:4–E2Q100X1:4–

I2_4/	IGBT4 power part 2 E2Q100 = 4512 108 05882
I2_4	IGBT4 power part 2 E2Q100 ≥ 4512 108 08621 *
	EZ130X1:A25–EZX34:17–E2Q100X1:17–
	value: on = 3.7V off = 1.2V against ground * = X10
	measuring point EQ100 R31 end to X1 * E2Q100 X9

IT_0V	emitter 0V exposure on signal
	EWA100X2:C9–EWAX14:9–
	part of: exon old world

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Iu	stator current U of Low Speed Rotor Control low speed measuring point EYAX22
Iw	stator current W of Low Speed Rotor Control low speed measuring point EYAX21
MN_EM_OF	mains power emergency off EZX4:1–EZX47:6–EN100X1:6–
MN_ON	mains on C300X1:6–EZX46:6–EZX47:2–EN100X1:2–EZX44:14–
NG_15V	– 15 V supply Vee EZ102X2:DBZ24–EZ119X2:AC12–EZ130X2:AC12–EZ139X2:AC12–EZ150C2:AC12–EZX21/22/31/32/41:6–EZX35:15– EZX51:8–EZX151:8–EG100X14:15– EZX31:6–EZX32 –14.5V ..... –15.5V
NR_PR_X/	not ready preparing for X–ray (low active) EZ139X1:A3–EZX23:3–EZX45:4–EZX46:4–C300X1:4– –EWAX51:4–EWAX52:4–EWA100X2:A24– driven by CU measuring point: EZX83 part of: signal bus
PO_12V	+ 12 V supply EN100X1:1–EZX47:1–EZX46:7–C300X1:7–
PO_15V	+ 15 V supply Vdd EZ102X2:DBZ22–EZ119X2:AC11–EZ130X2:AC11–EZ139X2:AC11 –EZ150X2:AC11–EZX2:8/9–EZX35:7–EZX44:12/13–EZX46:5 –EZX51:7–EG100X14:7–C300X1:5 –EZX21/22/31/32/41:5 only generator basis 4512 104 70202/70601 –EZX151:7 generator basis ≥ 4512 104 70203/70602 +14.5V ..... +15.5V
PO_15/40V	+ 15 V or + 40 V supply for measuring chamber EZ150X1:A20–EZX21/22/31/32/41:5
PO_26V	+ 26 V supply EZ102X2:DBZ28–EZ119X2:AC14–EZ130X2:AC14–EZ139X2:AC14 –EZ150X2:AC14–EZX1:5–EZX2:3–EZX3:9–EZX11:1–EZX17:1–EZX18:1–EWAX1:4– –EWAX2:4–EWAX3:4–EWAX4:4–EWAX41:1–EWAX23:9–EWAX24:5–EWA100X2:A14–EWA100X2:C14– –EQ100X2:1–E2Q100X2:1–
PO_26V_1	+ 26 V supply optional EZ102X2:DBZ32–EZX19:1–EZX20:1– EZX8:1 generator basis ≥ 4512 104 70203/70602
PO_26V_RE	+ 26 V supply reverse EWAW11–EWAW12–EWAX1/2/3/4:4–EWAX42:1– if generator and system release voltage are of the same polarity PO_26V_RE = +26V, if not PO_26_RE = 0V against –24V
PO_26V_SW	+ 26 V supply switched EZ102X1:D32–EZX7:1–EM1 generator basis ≥ 4512 104 70203/70602

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PO_400V	+ 400 V supply measuring chamber EZ150X1:AC1–EZX21/22/31/32/41:1– +400V , Ri=100k
PO_5V	+ 5 V supply Vcc EZ102X2:DBZ2/4/6–EZ119X2:AC1/2–EZ130X2:AC1/2–EZ139X2:AC1/2–EZ150X2:AC1/2–EZX46:9–C300X1:9– EZX51:4/5/6–EZX151:4/5/6 +4.74V ..... +5.25V
PO_V	signal bus supply EZX23:13/25–EZX44:5–EZX45:7–EWAX51/52:7– EWA100X2:AC27–EZ139X1:AC6– Vsgn part of: signal bus
POWERFAIL/	power fail signal of power supply EZ102X1:D30–EZ139X1:A10–
PW_ON_NG	DC supply relay power on negative EZ130X1:A15–EZX47:9–EN100X1:9– 0V/+15V, low active
PW_ON_PO	DC supply relay power on positive EZ130X1:C15–EZX47:4–EN100X1:4– +15V
RC_ON/	rotor control on EZ150X1:A25–EZX51:1–
RC_RD/	rotor control ready EYAX1:9(low speed)–EXZ51:9–EZ150X1:C25– measuring point EYAX25 low speed rotor control
RC_ST_2/	rotor control stator 2 EZ150X1:A26–EZX16:1(low speed)–EY100X3:1(high speed)–EWGX14:1
RC_ST_3/	rotor control stator 3 EZ150X1:C26–EZX16:2(low speed)–EY100X3:2(high speed)–EWGX14:2–EWGX15:1–E1WGX14:1
RD_MN_ON	ready mains power on C300X1:14–EZX46:14–EZX47:7–EN100X1:7–
RD_PR_X NR_PR_X/	ready preparing for X–ray or not ready preparing for X–ray (low active) EZ139X1:A3–EZX23:3–EZX45:4–EZX46:4–C300X1:4– –EWAX51:4–EWAX52:4–EWA100X2:A24– driven by CU measuring point: EZX83 part of: signal bus
REL_CH1	release (reset integrator) chamber 1 EZ150X1:C6–EZX21:4–
REL_CH2	release (reset integrator) chamber 2 EZ150X1:A6–EZX22:4–

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REL_CH3	release (reset integrator) chamber 3 EZ150X1:C12–EZX31:4–
REL_CH4	release (reset integrator) chamber 4 EZ150X1:A12–EZX32:4–
REL_CH5	release (reset integrator) chamber 5 EZ150X1:C18–EZX41:4–
RESET_C/	system RESET command EZ130X2:A6–EZ119X2:A6–EZ139X2:A6–EZ150X2:A6–EZX45:3–EZX46:3–C300X1:3– –EZX51:10–EZX52:3–EZX73–EWAX51:3–EWAX52:3–EWA100X1:A6– 0V/5V measuring point EZX73 driven by CU, active (low) if: EZ139 S1 activated, RESET_SW/ active, threatening power supply drop in, watchdog alarm, switch on (button), resets FU's drop in, part of: XS/XRG bus
RESET_SW/	signal bus reset, generator reset EZX23:2–EZX44:6–EZ139X1:A2– low active $\tau \geq 200$ms (τ = 8.41 WP) resets CU measuring point: EZX81 part of: signal bus
RF_0V_CH1	0V reference value measuring chamber 1 EZX21:8–EZ150X1:C8– differential signal with SIGN_CH1
RF_0V_CH2	0V reference value measuring chamber 2 EZX22:8–EZ150X1:A8– differential signal with SIGN_CH2
RF_0V_CH3	0V reference value measuring chamber 3 EZX31:8–EZ150X1:C14– differential signal with SIGN_CH3
RF_0V_CH4	0V reference value measuring chamber 4 EZX32:8–EZ150X1:A14– differential signal with SIGN_CH4
RF_0V_CH5	0V reference value measuring chamber 5 EZX41:8–EZ150X1:C20– differential signal with SIGN_CH5
RG_DV_1	registration device 1 selected EWA100X1:C4–EWAX1:5–
RG_DV_2	registration device 2 selected EWA100X1:A7–EWAX2:5–

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RG_DV_3	registration device 3 selected EWA100X1:A9–EWAX3:5–
RG_DV_4	registration device 4 selected EWA100X1:A11–EWAX4:5–
RM_DR_0V	room door contact 0V EZ150X1:C28–EZX1:10–
RM_DR_CT	room door contact EZX1:8–EZ150X1:A28–
RQ_SN_X/	request synchronization of X–ray EZX23:16–EZX45:12–EZX46:12–C300X1:12–EZ139X1:C3––EWAX51:12–EWAX52:12–EWA100X2:A25– measuring point: EZX84 part of: signal bus
RQ_XG_EX	request X–ray generator for exposure EWAX1/2/3/4:1–EWA100X1:A3
RQ_XG_FL	request X–ray generator for fluoroscopy EWAX1/2/3/4:6–EWA100X1:A5
RQ_XG_PR_1	request X–ray generator for preparation EWAX1:3–EWA100X1:A4–
RQ_XG_PR_2	request X–ray generator for preparation EWAX2:3–EWA100X1:C6–
RQ_XG_PR_3	request X–ray generator for preparation EWAX3:3–EWA100X1:C8–
RQ_XG_PR_4	request X–ray generator for preparation EWAX4:3–EWA100X1:C10–
RX_CAN_1	system CAN 1 optional EZX44:3–EZ139X1:C15– part of: system CAN
RX_CAN_2	system CAN 2 optional EZX43:1–EZX44:11–
S_CAN_L (CAN_N)	system CAN low active EZ139X1:C16–EZX42:2–EZX43:2– part of: system CAN
S_CAN_H (CAN_P)	system CAN high active EZ139X1:A16–EZX42:7–EZX43:7– part of: system CAN

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S_CAN_PO	system CAN supply EZX42:9–EZX43:9–EZX44:4–EZ139X1:A17– Vcan part of: system CAN
SI_PH_ID SI_PH/	single phase identifier EN100X1:5–EZX47:5–EZ130X1:C14–
SIGN_CH1	signal ramp of measuring chamber 1 EZX21:7–EZ150X1:C7– 0...12V (24V out of range possible) differential signal with FR_0V_CH1
SIGN_CH2	signal ramp of measuring chamber 2 EZX22:7–EZ150X1:A7– 0...12V (24V out of range possible) differential signal with RF_0V_CH2
SIGN_CH3	signal ramp of measuring chamber 3 EZX31:7–EZ150X1:C13– 0...12V (24V out of range possible) differential signal with RF_0V_CH3
SIGN_CH4	signal ramp of measuring chamber 4 EZX32:7–EZ150X1:A13– 0...12V (24V out of range possible) differential signal with RF_0V_CH4
SIGN_CH5	signal ramp of measuring chamber 5 EZX41:7–EZ150X1:C19– 0...12V (24V out of range possible) differential signal with RF_0V_CH5
SL_CO_1	select correction 1 (thickness) EWA100X1:A32–EWAX24:8–
SL_CO_2	select correction 2 (thickness) EWA100X1:C32–EWAX24:9–
SL_PG_1	select ext APRT program 1 EWA100X1:A28–EWAX23:1–
SL_PG_2	select ext APRT program 2 EWA100X1:C28–EWAX23:2–
SL_PG_3	select ext APRT program 3 EWA100X1:A29–EWAX23:3–
SL_PG_4	select ext APRT program 4 EWA100X1:C29–EWAX23:4–

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SL_PG_5	select ext APRT program 5 EWA100X1:A30–EWAX23:5–
SL_PG_6	select ext APRT program 6 EWA100X1:C30–EWAX23:6–
SL_PG_7	select ext APRT program 7 EWA100X1:A31–EWAX23:7–
SL_PG_8	select ext APRT program 8 EWA100X1:C31–EWAX23:8–
SL_TO_TM_1	select tomo time 1 EWAX21:1–EWA100X1:A24–
SL_TO_TM_2	select tomo time 2 EWAX21:2–EWA100X1:C24–
SL_TO_TM_3	select tomo time 3 EWAX21:3–EWA100X1:A25–
SL_TO_TM_4	select tomo time 4 EWAX21:4–EWA100X1:C25–
SL_TO_TM_5	select tomo time 5 EWAX21:5–EWA100X1:A26–
SL_TO_TM_6	select tomo time 6 EWAX21:6–EWA100X1:C26–
SL_TO_TM_7	select tomo time 7 EWAX21:7–EWA100X1:A27–
SL_TO_TM_8	select tomo time 8 EWAX21:8–EWA100X1:C27–
SL_XG_TO	select X–ray generator for tomography EWAX11:3–EWAX12:3–EWA100X1:C18–
STOP_X_C/	stop X–Ray command, X–ray off from FU EZ119X2:A7–EZ130X2:A7–EZ150X2:A7–EZX52:4–EZ139X2:A7– 0V/5V measuring point EZX75 inactivates CTRL_X_C/ EXOF exposure off command part of: XS/XRG bus
STU	stator line U EYAX2:2(low speed)–EY100X6:2(high speed)–EWGK11/K12:1 part of: low/high speed rotor control

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STV	stator line V = common EYAX2:3(low speed)–EY100X6:3(high speed)–EWGK11/K12:3 part of: low/high speed rotor control
STW	stator line W EYAX2:4(low speed)–EY100X6:4(high speed)–EWGK11/K12:5 part of: low/high speed rotor control
SW_BU_1	switch bucky EWAX11:10–EWA100C1:C19– part of: bucky ready contact
SW_BU_2	switch bucky 2 (EWA or EWB) or 4 (EWB) EWAX12:10–EWA100X1:A21– –EWB100X1:A21–EWBX12:10– part of: bucky ready contact
SW_SF_CF_1	switch side field to central field bucky measuring chamber EWAX11:1–EWA100X1:A18–
SW_SF_CF_2	switch side field to central field bucky measuring chamber 2 (EWA or EWB) or 4 (EWB) EWAX12:1–EWA100X1:A20–
SW_TO_1	switch tomography 1 EWAX11:5–EWA100X1:A19– part of: tomo ready contact
SW_TO_2	switch tomography 2 EWAX12:5–EWA100X1:C20– part of: tomo ready contact
SW_UN_EX	radiation indication EZ150X1:A29–EZX1:4–
TB_2/	tube 2 selected EZ130X1:A13–EZX11:2–EWGX11:2 0V/15V, low active
TB_2_RT	tube 2 selection check EWGX11:3–EZX11:3–EZ130X1:A10 0V/5V, low active
TB_3/	tube 3 selected EZ130X1:C13–EZX11:5–EWGX11:5–EWGX12:2 0V/15V, low active
TB_3_RT	tube 3 selection check E2WGX11:3–E1WGX12:3–E1WGX11:6–EZX11:6–EZ130X1:C10– 0V/5V, low active
TB_CU_FR_NG	tube current frequency negative EG100X14:14–EZX35:14–EZ119X1:BZ32– –15V against ground

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TB_CU_FR_PO	tube current frequency positive EG100X16:6–EZX35:6–EZ119X1:BZ30– 15V against ground, frequency: 1 kHz ≙ 2 mA, 0...1500mA 500kHz/A
TH_OL	tube housing overload EZX3:6–EZ130X1:A12– (generator basis 4512 104 70202/70601 only) EZX3:3–EZ130X1:A12– 0...5V
TH_OL_SW/	tube housing overload switch EZX3:3–EZ130X1:A11– (generator basis 4512 104 70202/70601 only) EZX3:6–EZ130X1:A11– 0V/26V, low active
TO_MO_PG	tomo mode programmed EWA100X1:A17–EWAX22:9–
TO_PG_1	tomo program 1 EWA100X1:A13–EWAX22:1–
TO_PG_2	tomo program 2 EWA100X1:C13–EWAX22:2–
TO_PG_3	tomo program 3 EWA100X1:A14–EWAX22:3–
TO_PG_4	tomo program 4 EWA100X1:C14–EWAX22:4–
TO_PG_5	tomo program 5 EWA100X1:A15–EWAX22:5–
TO_PG_6	tomo program 6 EWA100X1:C15–EWAX22:6–
TO_PG_7	tomo program 7 EWA100X1:A16–EWAX22:7–
TO_PG_8	tomo program 8 EWA100X1:C16–EWAX22:8–
TO_PG_SL	tomo program selected EWA100X1:C17–EWAX22:10–
TP_HT_GND	temperature high tension tank ground EZ130X1:A19–EZX35:12–EG100X14:4–
TP_HT_SG	temperature signal high tension tank EG100X14:12–EZX35:4–EZ130X1:C19– 0...5V +25 °C(12kΩ)...+100 °C(950 Ω)

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V15C S_CAN_PO	system CAN supply EZX42:9–EZX43:9–EZX44:4–EZ139X1:A17– Vcan part of: system CAN
V15S PO_V	signal bus supply EZX23:13/25–EZX44:5–EZX45:7–EWAX51/52:7– EWA100X2:AC27–EZ139X1:AC6– Vsgn part of: signal bus
X_ACT/	signal bus X–ray active EZ139X1:A5–EZX23:5–EZX45:6–EWAX51/52:6–EWA100X2:C24– driven by CU, X_ACT_S/ status dependent, old: EXON signal measuring point: EZX86 part of: signal bus 0V/15V
X_ACT_S/	X–Ray active signal, kV > 75% nominal value or 'fluoroscopy technique' high tension on EZ119X2:A8–EZ130X2:A8–EZ139X2:A8–EZ150X2:A8–EZX52:5– 0V/5V measuring point EZX77 HTON (high tension on) or FLON (fluoroscopy high tension on) signal part of: XS/XRG bus, controls X_ACT/ status
XG_RD_EX_1	X–ray generator ready for exposure request EWA100X1:C3–EWAX1:2–
XG_RD_EX_2	X–ray generator ready for exposure request EWA100X1:A6–EWAX2:2–
XG_RD_EX_3	X–ray generator ready for exposure request EWA100X1:A8–EWAX3:2–
XG_RD_EX_4	X–ray generator ready for exposure request EWA100X1:A10–EWAX4:2–

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10. Function unit kV

Switch–on not possible:

- ENF1 released.
- ENF1 not switched on (visual check).
- ENF2 released by low–voltage supply
  filament circuit
  tube extension
  external components supply.
- FNF2 not switched on (visual check).
- "ON" circuit EN100 defective.

Phase supervision

a) Without mains adaptation transformer:

- Phase L1 is missing: Mains contactors ENK2 and ENK1 cannot be activated.
- Phase L2 is missing: The generator can be switched on but does not go into the READY state.
  The filament–circuit supply is missing.
  There is an error message from function unit kV.
- Phase L3 is missing: "ON" circuit without supply voltage.

Fault tracing:

Check leads and fuses up to the mains supply.

b) With mains adaptation transformer:
In case at least one phase at the primary end is missing, the generator cannot be switched on. If there is a problem concerning the leads at the secondary end, refer to a).

After switch–on or attempted switch–on:

The generator cannot be brought into the READY state (e.g. no desk display).

Check the low–voltage supply.

- ENF1 released:
  Ground fault/short–circuit of one/several phase(s).
  Check ENK2 and, if necessary, the contacts of ENK1.
  Check the leads and the mains adaptation transformer.
  Have contacts ENK2 or ENK1 dropped out?
  Check visually. Be careful when doing so since the unit is still connected to mains.
- Missing voltage of intermediate circuit:
  The damping resistors are unsoldered which was caused by overcurrent during switch–on.
  Cause: Short–circuit in the converter, defective charging capacitors, mains–filter capacitors or rectifiers.
  Unsoldering happens about 45 sec. after switch on.

The damping resistors are unsoldered because the converter was active and ENK1 was not switched on although activated by the software.
Probably termination of exposure.

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This procedure can only happen once since the generator cannot go into STANDBY when intermediate–circuit voltage E is missing.

In case intermediate–circuit voltage E is present, ENK1 is activated by the software of the kV–control and remains activated for the complete time the unit is in operation.

In case of high impedance or when the tolerance of the symmetry resistors of the intermediate–circuit capacitor battery is too large, capacitors may be destroyed by overvoltage. In case ENK1 has already been activated, ENF1 will probably release.

ENF3 is released by the rotor control units.

The release of ENF2 switches the generator off since the supply voltage for the "ON" circuit and, consequently, the supply voltage of contactors ENK2 and ENK1 is interrupted.

Converter

Resonant capacitor(s) defective:

- At least one of the two capacitors is ineffective:
  High voltage is not possible with the 50 kW version.
  Asymmetry or too low kV with the 65/80/100 kV versions.
- Short–circuit on one of the two capacitors (in case both capacitors are concerned, ENF1 will be released):
  Low resonant–circuit frequency.
  The IGTBs can break because of overcurrent.
  Overvoltage at the resonant capacitor which is intact.
  kV overswing.
  DC short–circuit current possible because of resonant current which has not yet died off.

Snubber diode on kV power board defective:

- High impedance:
  IGBTs defective. DC short–circuit current causes the release of ENF1.
- Short–circuit:
  IGBTs defective. DC short–circuit current causes the release of ENF1. The resistors of the protective wiring might be destroyed in advance.

The fan for the IGBT heat sinks fails:
The temperature is measured and a (warning) message is given via the software.
The converter is switched off when the limit values are exceeded (error).
This might be caused by failure of the +26 V/+15 V supply of the fan.

The NTC resistor for temperature measurement is supervised via the software with respect to logical values.
The valid temperature range is between these error conditions.

Open/shorted measuring circuits or any values going beyond the temperature limits will cause an error message.

In case of short–circuit in the NTC resistor the fan motor runs continuously. If the NTC is open the fan runs with 50% of max. speed.

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11. Functional description of function unit mA

Tube data of Philips products must be loaded as a data set from floppy disk via PC and central unit CU to into function unit mA.

In case non–Philips products are concerned, the tube data must be entered manually before tube adaptation can successfully be carried out.

The procedures described below cannot be carried out before the complete data set for the tube housing assembly is present in central unit CU.

Before the tube adaptation can be started, tube conditioning must be implemented.

With the present generator release the conditioning must be implemented manually.

Later on the conditioning program will take place automatically.

Before adaptation can be started, the mA offset value of the mA measuring circuit must be determined.

This offset value consists of two components:

1. A current of 4 mA is impressed upon the mA measuring circuit which is used for continuous calibration (during STANDBY about once per minute).
2. In addition to this the kV measuring circuit delivers an offset current depending on the kV.

To measure this total value an exposure must be released with 40 kV without filament current. The current measured is the correction value for all standard exposures (4 mA, measuring circuit current depending on the kV).

As opposed to the standby filament current value of the predecessor versions of the generator, the standby filament current value of the OPTIMUS generator is not fixed.

It is determined for each focus individually. A 40 kV exposure must be released with the focus to be measured while all other foci are switched off.

The filament current must be changed until an emission current of 100 µA is obtained.

The associated filament current value is the individual standby filament current (1% to be substracted so that the fluoroscopic current of any of the other foci is not affected).

The adaptation program takes place fully automatically.

Based on 120 single exposures for each focus a data field is created in the CMOS of function unit mA. The adjustments for all other exposures are interpolated from this data field during operation.

During the adaptation procedure any limit values such as maximum filament current, maximum kV, maximum tube load, maximum output, current of the generator etc. are taken into account.

Boost adaptation

Boost time determination (positive boosting).

With the predecessor versions of the generator, a **calculated boost current** was added to the exposure filament current for a **fixed time** of 400 ms.

With OPTIMUS generators the boost current is also fixed but with a **variable time.**

The amount of the boost current is the sum of the maximum filament current (of the respective filament) plus 2000 mA.

To determine the time values an exposure must be started in the kV isowatt point (determined from tube and generator parameters).

As soon as the 100% kV value is reached, the maximum filament current plus 2000 mA is adjusted by function unit mA. The emission current is measured every 2 ms until the maximum tube current or the maximum possible generator current is reached.

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In case this procedure takes too long (warming up of the tube), the measurement is continued with a second exposure after a sufficient period of time has passed.

The measurement starts again at the value obtained last.

An innovation of the OPTIMUS generator is the determination of the **negative boosting** (blanking of the filament current).

The measurement is started with the same kV isowatt exposure which is used for the determination of the positive boost time but with maximum filament current.

As soon as the 100% kV value is reached, the maximum filament current of the filament circuit is abruptly reduced to 500 mA.

Every 2 ms the emission current is measured until a value of 100 µA is obtained.

The values for the blanking times are required for techniques such as, for instance, cine.

A filament current value of 500 m must not be exceeded for otherwise the output to supply a gridswitch box (which might be present) is too low.

The following procedure takes place after the generator has been switched on:

Function unit mA initializes itself and afterwards establishes connection with central unit CU via CAN.

For 3 seconds all foci are boosted with their respective specified maximum filament current. Then blanking of the filament current (500 mA) takes place for a variable period of time (derived from negative boost adaptation) to bring the filament current to the STANDBY value.

The change of the filament current value upon a change of the focus which was the usual routine for the predecessor versions of the OPTIMUS generator does no longer take place – all STANDBY values remain constant.

During operation the following procedure takes place after the release of PREP:

- The filament current is raised from the individual STANDBY filament current which depends on the focus to the boost current.

The switch–on time of the boost current results from the difference between STANDBY and intermediate filament current.

- The intermediate filament current is a calculated value. It is calculated in such a way that the filament current and thus the filament temperature is brought to exposure level when the boost current is switched off for 50 ms directly at the end of the preparation phase (RQ_SN_X/ already active) and/or directly before high voltage is switched on (RQ_SN_X/ active when the patient is quiet).
- During exposure the filament current is regulated as required.
- At the end of exposure the filament current is reduced to the minimum value of 500 mA (negative boosting) for a short time.

  At the same time the temperature of the filament abruptly drops to a level which corresponds to the level of the intermediate filament current.

  Afterwards heating takes place with the intermediate filament current.

  Now the tube would be ready for the next exposure with the same preparation.
- In case preparation is released, negative boosting takes place until heating can go on with the STANDBY filament current.

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A2/A4 95-05-24 Schr./Ost.
u00637

Central rack, service aid

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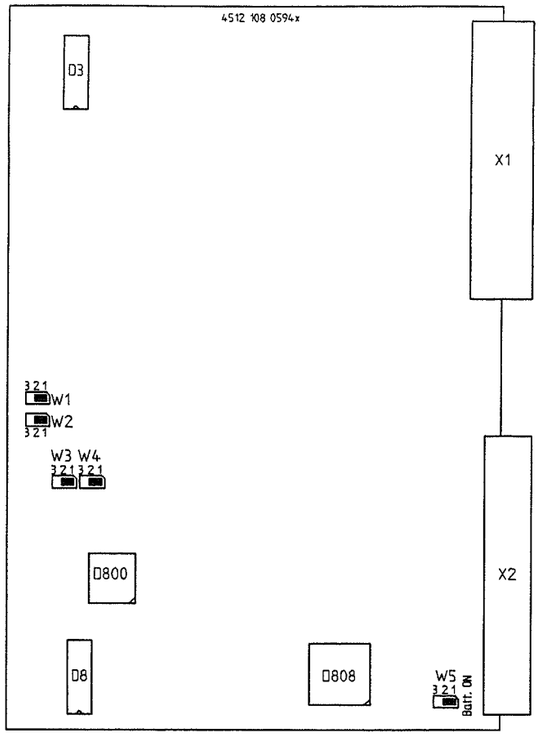
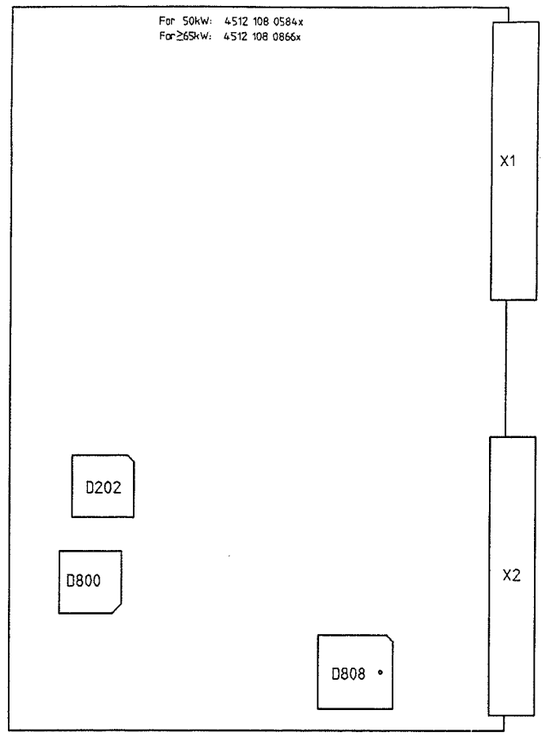
EZ 119 mA control



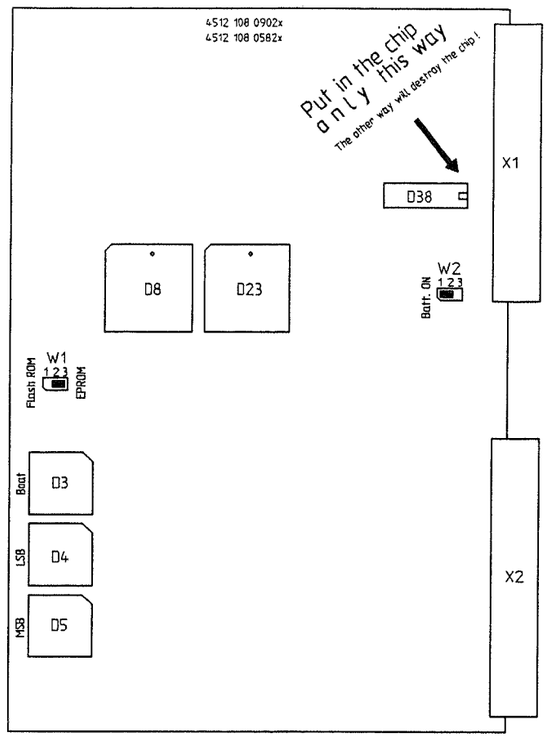
D3 = 4512 113 18091
D8 = 18081
D800 = 20203
D808 = 18061

EZ 130 kV control (50kW)/ kV control 2 (≥65kW)



	kV control (50kW)	kV control 2 (≥65kW)
D200 =	4512 113 18111	18111
D202 =	18121	18121
D800 =	20112	20112
D808 =	18061	18061

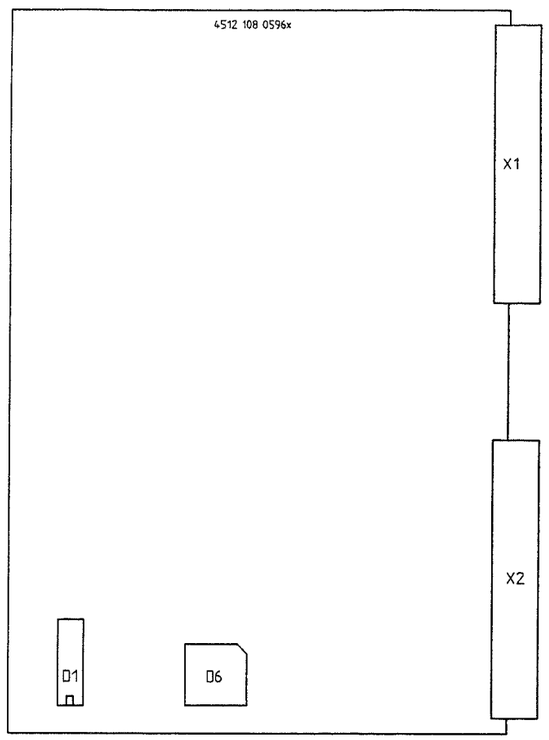
EZ 139 Central unit



D3 = 4512 113 20711
D8 = 18041
D23 = 18051
D38 = function key, marked with s/n of the generator

Rel. 1.1
D4 = 4512 113 18024
D5 = 18034

EZ 150 Basic interface



D1 = 4512 113 18071
D6 = 20301

A1/A3 95-06-02 Schr./Ost.
ua0636

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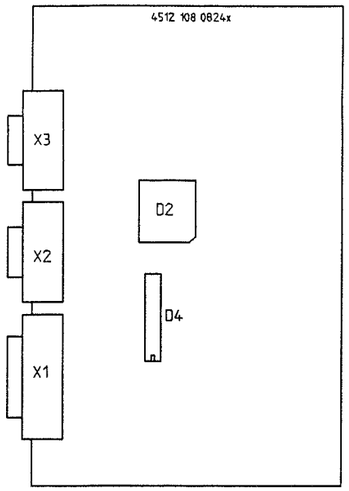
PCB programming central rack EZ

Operating desk C

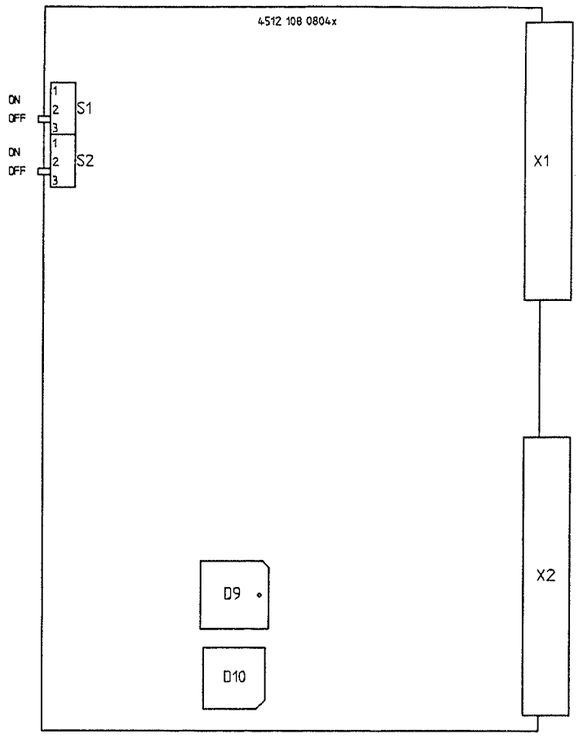
C 300 CPU



D2 = 4512 113 20504
D4 = 18071

Adapter decade cable WA, 1WA, 2WA

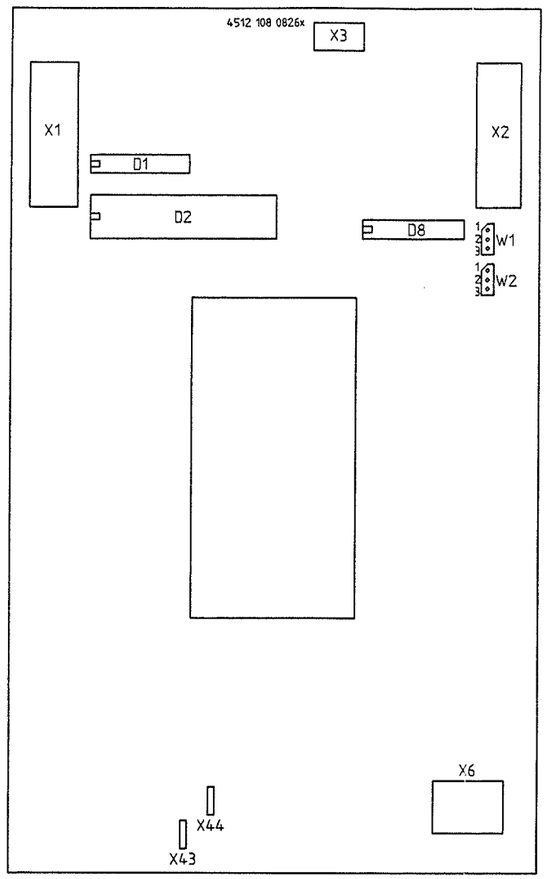
WA 102 Universal I/O interface



D9 = 4512 113 18201
D10 = 20601

High speed rotor control Y

Y 100 Roco HS



Coding	Rotor control 1st	2nd	3rd
W1	1-2		
W2	1-2		

D1 = 4512 113 18071
D2 = 20401
D8 = 18101

A1/A3 95-05-05 Ost.
ua0647

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ACCEPTANCE

Contents 7–0.1

1. **Preface** 7–1
2. **Test equipment** 7–1
3. **Setup** 7–1
4. **Test** 7–2

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1. Preface

The national rules for accepting a X–ray system are very different. Therefore in the following is given an example for checking the generator in the U.S.A.

OPTIMUS generators are factory–calibrated and checked for compliance with the parameter readout tolerances as stated in the relevant Operator's Manuals.

Provided these generators are installed and set to work in accordance with the Installation Manuals only the following limited field compliance testing is required.

2. Test equipment

- Keithley voltage divider model No. 35080 with filter packs 32867C, 5C, 9C or equivalent.
- Oscilloscope (storage)
- Digital mA, mAs meter.

Notes

Do not start test until generator has been switched on for at least one hour.

Direct (invasive) kVp measurements on OPTIMUS generators with HV divider tanks normally available to the field service organization are not permitted.

Measurements of kV using instruments other than the Keithley instrument may lead to larger measuring tolerances. The causes are to be found in the specific frequency response and transient response of each test instrument.

3. Setup

- Switch off generator and also switch off main disconnect breaker to system.
- Connect digital mA meter as per instructions in the relevant Service Manual.
- Set up the Keithley voltage divider complete with the appropriate filter as per Keithley Instructions Manual No. 3294 OIM.
- Connect the oscilloscope to the Keithley divider.

Note

Make sure that the oscilloscope has been calibrated with the aid of the Keithley divider as described in the Keithley Instructions Manual before starting any testing (par. 3.6. Internal calibration).

- Calculate rejection limits based on the exposure parameter "Specification Limits" shown in the table below.

  The "Specification Limits" are based on the actual tolerances as listed in the generator Operator's Manuals. These "Specification Limits" must be restricted to include the actual measuring instrument error. See also section 6, par. 3.1. of "Comprehensive Compliance Testing Manual" No. 4535 800 2034. regarding how to calculate rejection limits.

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4. Test

- Switch the system on.
- Measure the mains voltage on ENF1.

  Reference voltage: Mains voltage programmed ±10%

  Actual values: L1 – L2: V

  L1 – L3: V

  L2 – L3: V

- Select the largest focus.
- Release exposures according to the table below and compare the values measured with the reference values.

Technique	Parameter	Reference range	Measured value	Corrected value
3–knob technique	81 kV ±5% ±1 kV	76 ... 86 kV	..... kV	—
	250 mA ±5% ±0.5 mA	237 ... 263 mA	..... mA	..... mA
	100 ms ±5% ±0.5 ms	94.5 ... 105.5 ms	..... ms	—
2–knob technique	125 kV ±5% ±1 kV	118 ... 132 kV	..... kV	—
	80 mAs ±3% ±0.5 mAs	77.1 ... 82.9 mAs	..... mAs	..... mAs

Owing to an offset current in the measuring circuit of the HV generator the measured values for mA/mAs must be adjusted using the following formulas:

$$I_{corrected}\ [mA] = I_{measured}\ [mA] - \frac{U\ [kV]}{R_{calc.}\ [M\Omega]} \qquad \text{Offset} \approx 0.2 \ldots 0.75\ mA$$

$$Q_{corrected}\ [mAs] = Q_{measured}\ [mAs] - \frac{U\ [kV] \times t\ [ms]}{R_{calc.}\ [M\Omega]} - \underbrace{\frac{5\ [nF] \times U\ [kV]}{1000}}_{\text{Cable charge for 20 m HV cable} \approx 0.2 \ldots 0.75\ mAs}$$

$R_{calc.}$ = calculated measuring circuit resistance. Typical value: ≈ 200 MΩ
Is read out via service menu *"FU_mA/ Fault find/ Read I_e corrections"*.

Focus assignment:

Focus 1	=	tube 1, large focus
2	=	tube 1, small focus
3	=	tube 2, large focus
4	=	tube 2, small focus
5	=	tube 3, large focus
6	=	tube 3, small focus

t = exposure time according to desk display.

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Service Information Checklist

Equipment :
Artikel : _____ Type No. : _____

_____ Serial No. :
Fabrik-Nr. : _____

Installation Date :
_____ Montage-Datum : _____

N-Sheet No. Service - Information Nr.	Implemented / Durchgeführt		Remarks / Bemerkungen
	Date / Datum	Signature / Unterschrift	

N-Sheet No. / Service - Information Nr.	Implemented / Durchgeführt		Remarks / Bemerkungen
	Date / Datum	Signature / Unterschrift	

Drawings
Schematic diagrams

File: OPTIMUS.Z0-a95.0

Basis

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H.V.generator	Z1- 4.2
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Tube extension WG/1WG/2WG	Z1-14.2
Adaptor 4 auxil.units WA/1WA/2WA	Z1-15.1

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Function units CU and DRC
(Z1-5)

Power supply
(Z1-2)

Function unit kV
(Z1-3)

Function unit mA_a
(Z1-4)

Function unit CIE
(Z1-6)

Service PC — X5

EZ139
Central unit CU
Dose rate control DRC

EZX61
DRC input — X1

X1/X2 X1/X2

EZ102
Low voltage supply

X1 X2

5V
-15V
+15V
26V

EZ130
kV Control

X1 X2 X1 X1

EZ119
mA Control

X1 X1 X1/X2

EZ150
Basic interface

Room decade | Cooling unit | Measuring chamber 1 2 3 4 5

EZ X1 | EZ X2 | EZ X21 | EZ X22 | EZ X31 | EZ X32 | EZ X41

X1 X1 X1

X1/X2

System control

External signal bus — EZX23 — XS bus — XS bus

System CAN — EZX42 EZX43* — CAN — EZX44 — XRG bus

Function programming plug
- system control
- desk control

XS-bus — External XS-bus + Internal CAN — EZX45

XRG-bus

Internal CAN/XS-bus — EZX52*

Internal expansion

EZX47 — EN100X1

EZX46

26V 230V~ 26V

EZX6 EZX20 EZX13 EZX17 EZX18 EZX19

Decade cable adapter (option)

EZX34 EZX24

EZX35 EZX12

EZX3

EZX51

100X1

EYA
Rotor control
LS or HS
(low or high speed)

3~400V

Function unit RC_a

300X1

200X1

C
Operating panel

Function unit HI_a

100X1 100X1

100X2 100X2

E2Q
2nd power unit for P≥ 65kW

EQ
Power unit

X14 X15

EG
H.V. generator

X1000 X1000

stator supply

supervision

Tube

H.V. cables

EZX47

EZX4:1

EZX4:2

Emergency OFF

F3

100X1

K1
3~400...480V

X1100 X1100

Mains
3~400...480V
50/60Hz

F1

EN
Power supply

F2/K2

F3

EZX14 230V~ reserve

EZX15 230V~ reserve

230V~ stand

3~400V rotor control LS/HS

Remark:
* When not used CAN connections EZX43 and EZX52 must be provided with a termination resistor.

A1/A3 95-05-19 Ost.
V00252

OPTIMUS (95.0)

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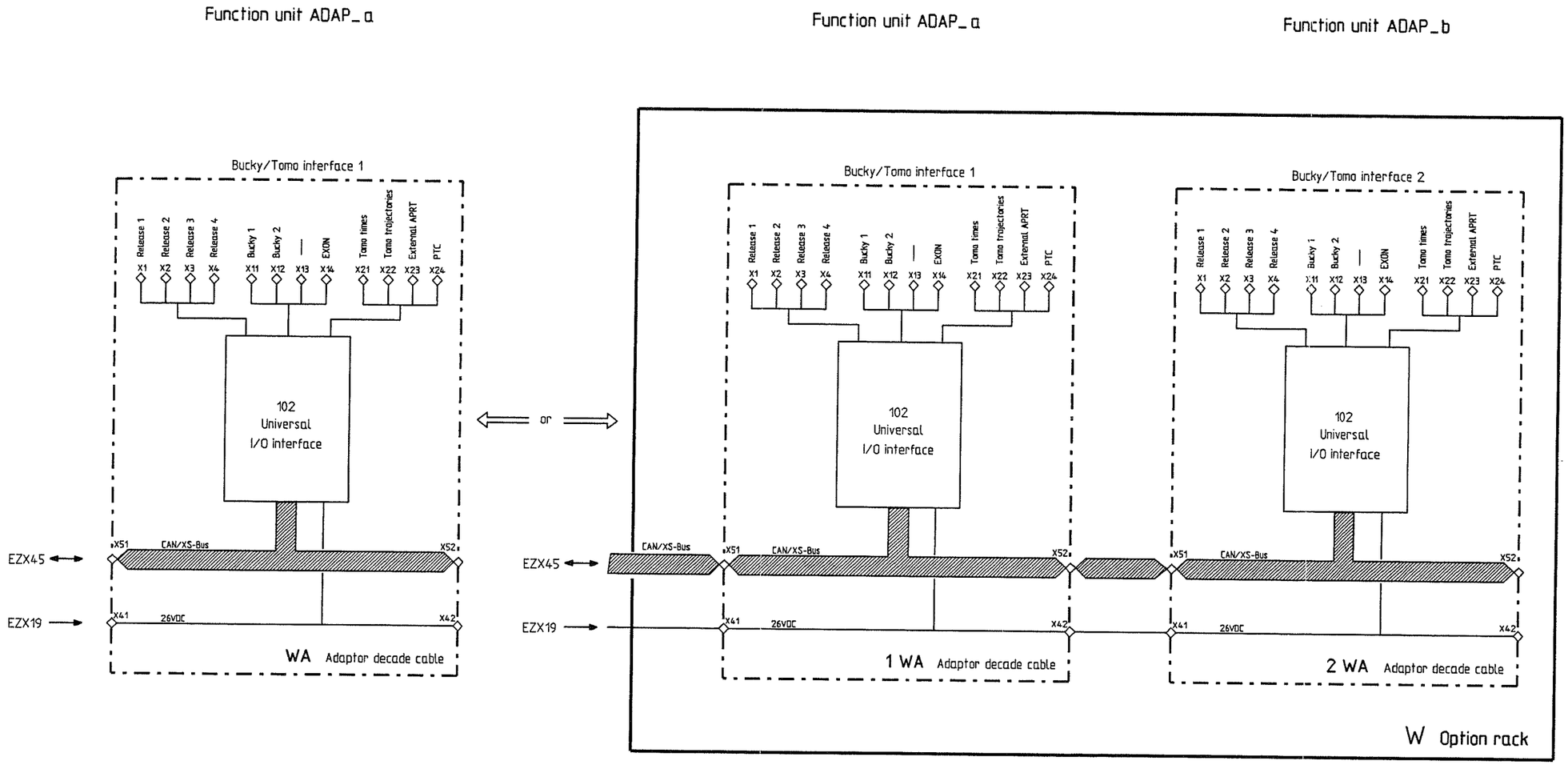
Block diagram
Basis

Z1-1.1



A1/A3 94-10-24 Schr./Gst.
u00615

Block diagram
Expansions

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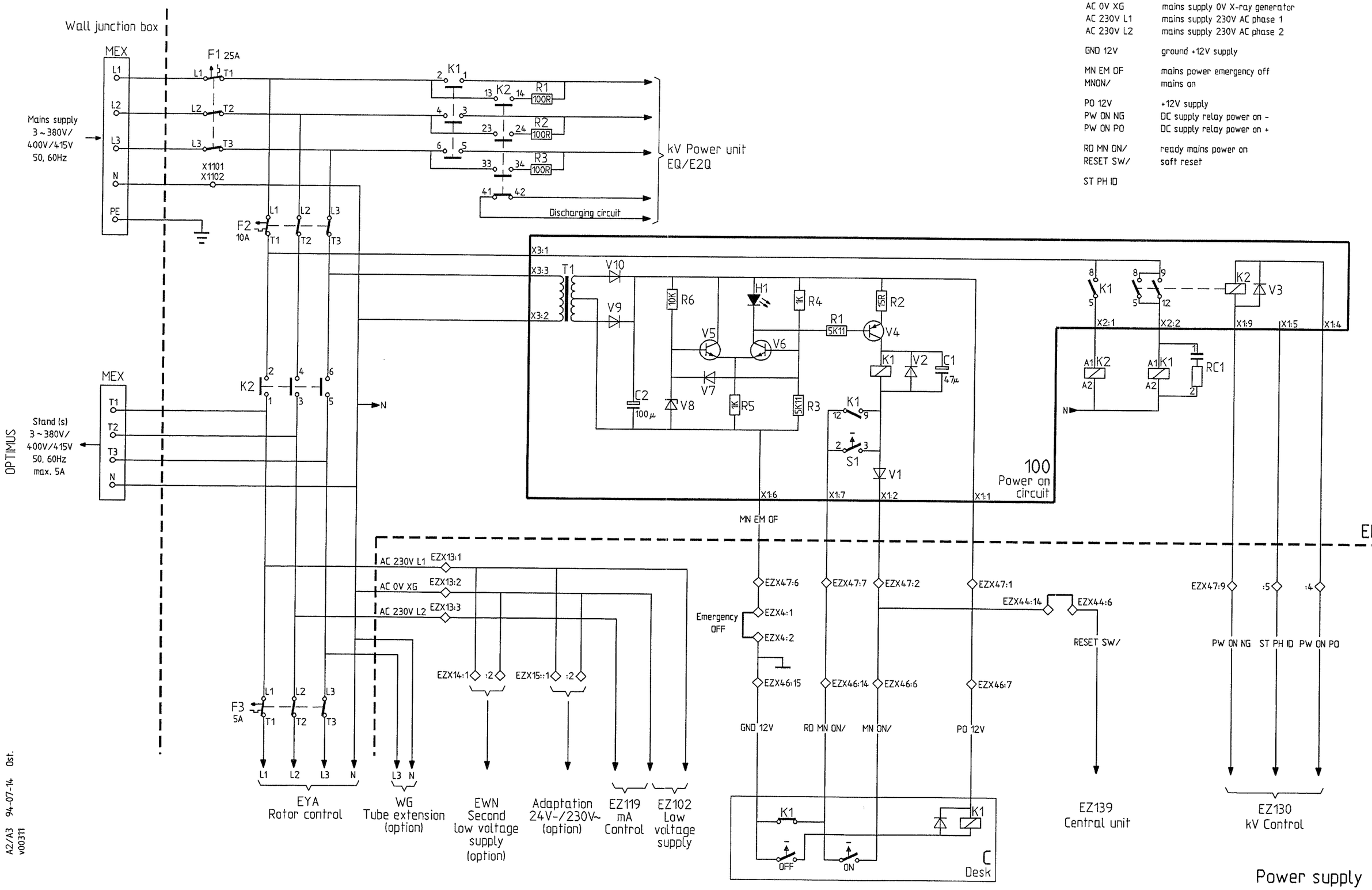
Mnemonic's

AC 0V XG	mains supply 0V X-ray generator
AC 230V L1	mains supply 230V AC phase 1
AC 230V L2	mains supply 230V AC phase 2
GND 12V	ground +12V supply
MN EM OF	mains power emergency off
MNON/	mains on
PO 12V	+12V supply
PW ON NG	DC supply relay power on -
PW ON PO	DC supply relay power on +
RD MN ON/	ready mains power on
RESET SW/	soft reset
ST PH ID	



OPTIMUS (94.0)

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Power supply

Z1-2.1

Wall junction box

MEX

F1 25A

Mains supply
3~ 380V...480V
50, 60Hz

L1 L2 L3 N PE

K1 K2 R1 100R · R2 100R · R3 100R

kV Power unit
EQ/E2Q

Discharging circuit

TX 1101 ..02 ..03 480V ..04 ..05 460V ..07 ..08 440V ..10 ..11 ..12 400V

Connected according to mains voltage.

L1 L2 L3

T

t
Thermo fuse

TX1201 ..02 ..03 ..04

F2
10A

X1101
X1102

MEX

K2

T1 T2 T3 N

Stand (s)
3~380/400V
50, 60Hz
max. 5A

N

F3
5A

L1 L2 L3 N

L3 N

EYA
Rotor control

WG
Tube extension
(option)

EWN
Second
low voltage
supply
(option)

EZX14:1 :2 EZX15:1 :2

Adaptation
24V-/230V~
(option)

EZ119
mA
Control

EZ102
Low
voltage
supply

AC 230V L1 EZX13:1
AC 0V XG EZX13:2
AC 230V L2 EZX13:3

X3:1 X3:3 X3:2 T1 V10 V9

R6 10K · R4 1K · R2 15R · R1 5K11

H1 V5 V6 V4 V7 V8 R5 1K R3 5K11

C2 100µ · C1 47µ

K1 V2 K1 S1 V1

X1:6 X1:7 X1:2 X1:1

100
Power on
circuit

MN EM OF

EN

EZX47:6 EZX47:7 EZX47:2 EZX47:1

Emergency
OFF

EZX4:1 EZX4:2

EZX46:15 EZX46:14 EZX46:6 EZX46:7

GND 12V RD MN ON/ MN ON/ PO 12V

EZX44:14 EZX44:6

RESET SW/

EZ139
Central unit

K1 K2 V3

X2:1 X2:2 X1:9 X1:5 X1:4

TX1205
Thermo fuse
TX1206

A1 K2 A2 · A1 K1 A2 · RC1

N

EZX47:9 :5 :4

PW ON NG SI PH ID PW ON PO

EZ130
kV Control

K1 OFF ON K1
Desk

Mnemonic's

AC 0V XG	mains supply 0V X-ray generator
AC 230V L1	mains supply 230V AC phase 1
AC 230V L2	mains supply 230V AC phase 2
GND 12V	ground +12V supply
MN EM OF MNON/	mains power emergency off mains on
PO 12V	+12V supply
PW ON NG	DC supply relay power on -
PW ON PO	DC supply relay power on +
RD MN ON/ RESET SW/	ready mains power on soft reset
SI PH ID	single phase identifier

OPTIMUS

A2/A3 94-08-22 Ost.
v00312

Power supply with mains transformer

Z1-2.2

OPTIMUS
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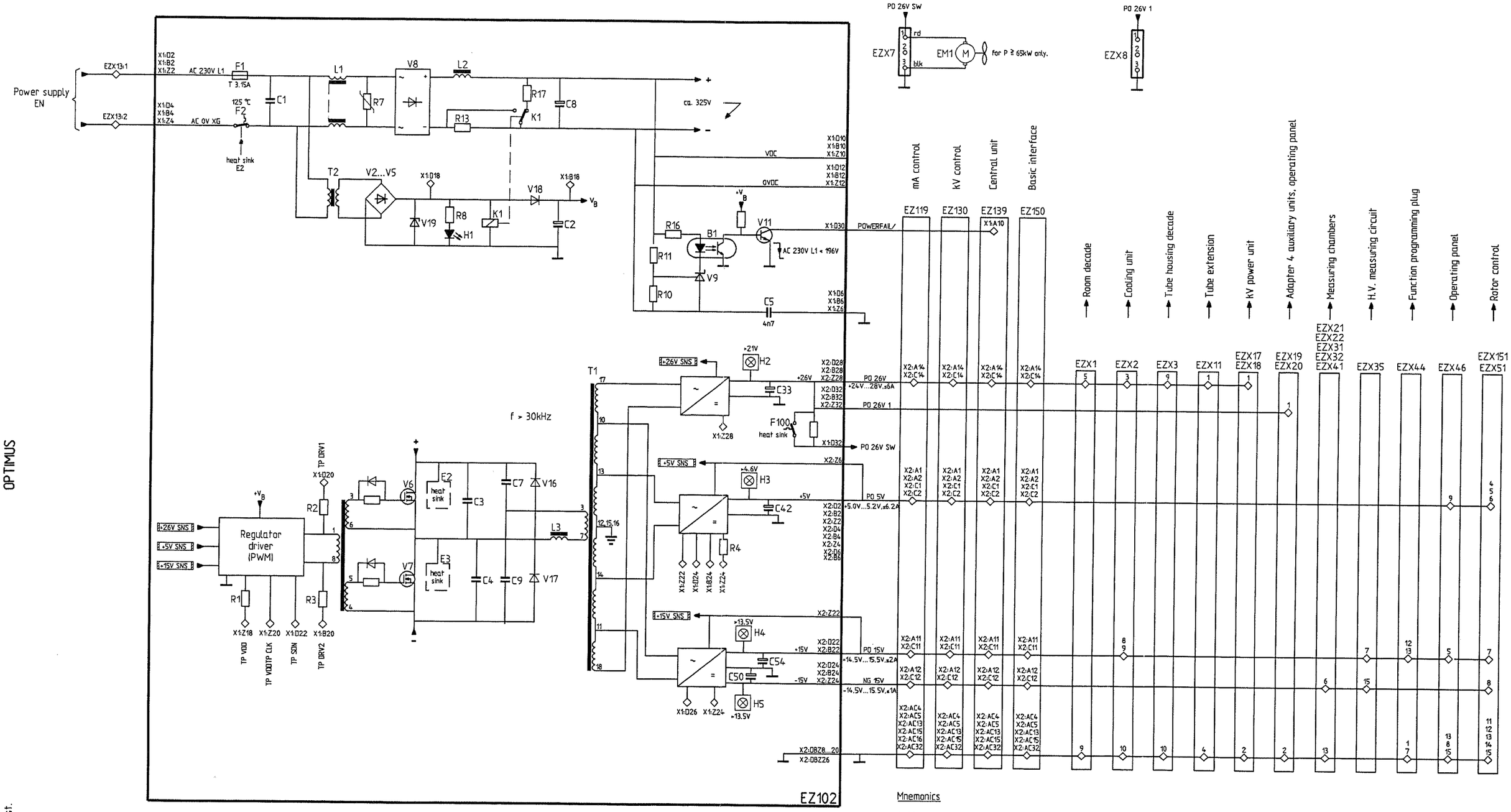
(94.1)



Mnemonics

0V DC	
+5V SNS	5V sense
+15V SNS	15V sense
+26V SNS	26V sense
AC 0V XG	mains supply 0V X-ray generator
AC 230V L1	mains supply 230V AC phase 1
NG 15V	-15V supply
PO 5V	+5V supply
PO 15V	+15V supply
PO 26V	+26V supply
PO 26V1	+26V supply optional
PO 26V SW	+26V supply switched
POWERFAI L/	power failure reset
TP CLK TP DRV1 TP DRV2 TP SDN TP VDD	} test points for internal signals
VDC	

Low voltage power supply

Z1-2.3

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EZ130
kV control
EZX24
(EZX34)

T1 galvanically decoupled power supply for drivers 1 and 2

T2 galvanically decoupled power supply for drivers 3 and 4

driver 1 / driver 2 / driver 3 / driver 4

Low voltage supply
EZ102

M1 blower

NTC 100k S2 heat sink for V1...V4

+480...750V

V1 Gate 1 Emitter 1 / V2 Gate 2 Emitter 2 / V3 Gate 3 Emitter 3 / V4 Gate 4 Emitter 4

V500 V501 V502 V503

C3 8µ C13 8µ

C504...507 4x47n

C508...511 4x47n

R506...508 3x39R

R509...511 3x39R

R501 200K R500 100K R504 200K R505 100K

V33 V34 10K R23 R24 C18 4.7n C19 4.7n

R514 R515 1K07 C500 22n C501 22n C502 100n C503 100n

X504 heat sink for V1...V4

E P0 CV1 (E P0 CV2)
CV1 ID/ (CV2 ID/)
CV1 GND (CV2 GND)
CV1 TM (CV2 TM)
CV1 GND (CV2 GND)
CV1 EN/ (CV2 EN/)
CV1 OL/ (CV2 OL/)
CV1 GND OL (CV2 GND OL)
E NG CV1 (E NG CV2)

EZX24 (EZX34) EZ130 kV control

100 kV power 4512 108 0866.

EQ (E2Q)

for P ≥ 65kW

E2Q

106 Measuring circuit

EG H.V. generator

Remarks

EQ = kV power unit for P ≤ 50 kW, mounted in the front of the generator.

E2Q = 2nd kV power unit for P ≤ 65 kW, mounted on the rear side of EQ.

(...) = any information in brackets is valid for E2Q.

Power supply 3~ 400 ... 480V 50, 60Hz

L1 L2 L3 X1101 X1102 X1103 V5 L2 R11 R1 C1 C2 C11 C12 3300µ 4x7K 480 ... 750V

EMC filter 200

Not connected if P≥ 65kW.

Discharging of DC circuit after switch-off of generator

ENK2

E20

Power supply 3~ 400 ... 480V 50, 60Hz

Mnemonics

E NG CV1	E value converter power part 1 DC supply negative	CV1 ID/	converter power part 1 identification	I1 3 I1 3/	IGBT3 power part 1
E NG CV2	" " " " " 2 " " "	CV2 ID/	" " " 2 "	I1 4 I1 4/	IGBT4 power part 1
E P0 CV1	E value converter power part 1 DC supply positive	CV1 OL/	converter power part 1 overload	I2 1 I2 1/	IGBT1 power part 2
E P0 CV2	" " " " " 2 " " "	CV2 OL/	" " " 2 "	I2 2 I2 2/	IGBT2 power part 2
CV1 EN/	converter power part 1 enable	CV1 TM	converter power part 1 temperature	I2 3 I2 3/	IGBT3 power part 2
CV2 EN/	" " " 2 "	CV2 TM	" " " 2 "	I2 4 I2 4/	IGBT4 power part 2
CV1 GND	converter power part 1 ground	I1 1 I1 1/	IGBT1 power part 1		
CV2 GND	" " " 2 "	I1 2 I1 2/	IGBT2 power part 1		
CV1 GND OL	converter power part 1 ground overload				
CV2 GND OL	" " " 2 " "				

OPTIMUS (a/95.0)

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A1/A3 95-05-18 Ost.
va0274

kV power unit

Z1-3.2

kV-control

EZ130

Low voltage supply
EZ102

H. V. generator, measuring circuit

kV power unit
EQ

Tube housing

kV power unit
EQA

Power supply
Tube extension

EZ

XRG - Bus

Decoupling and level matching

kV - brain

Hardware
kV regulator

PWM
stage

Decoupling and level matching

Tube extension

kV power unit
EQ, EZQ

EN100 K2
Power ON
contactor

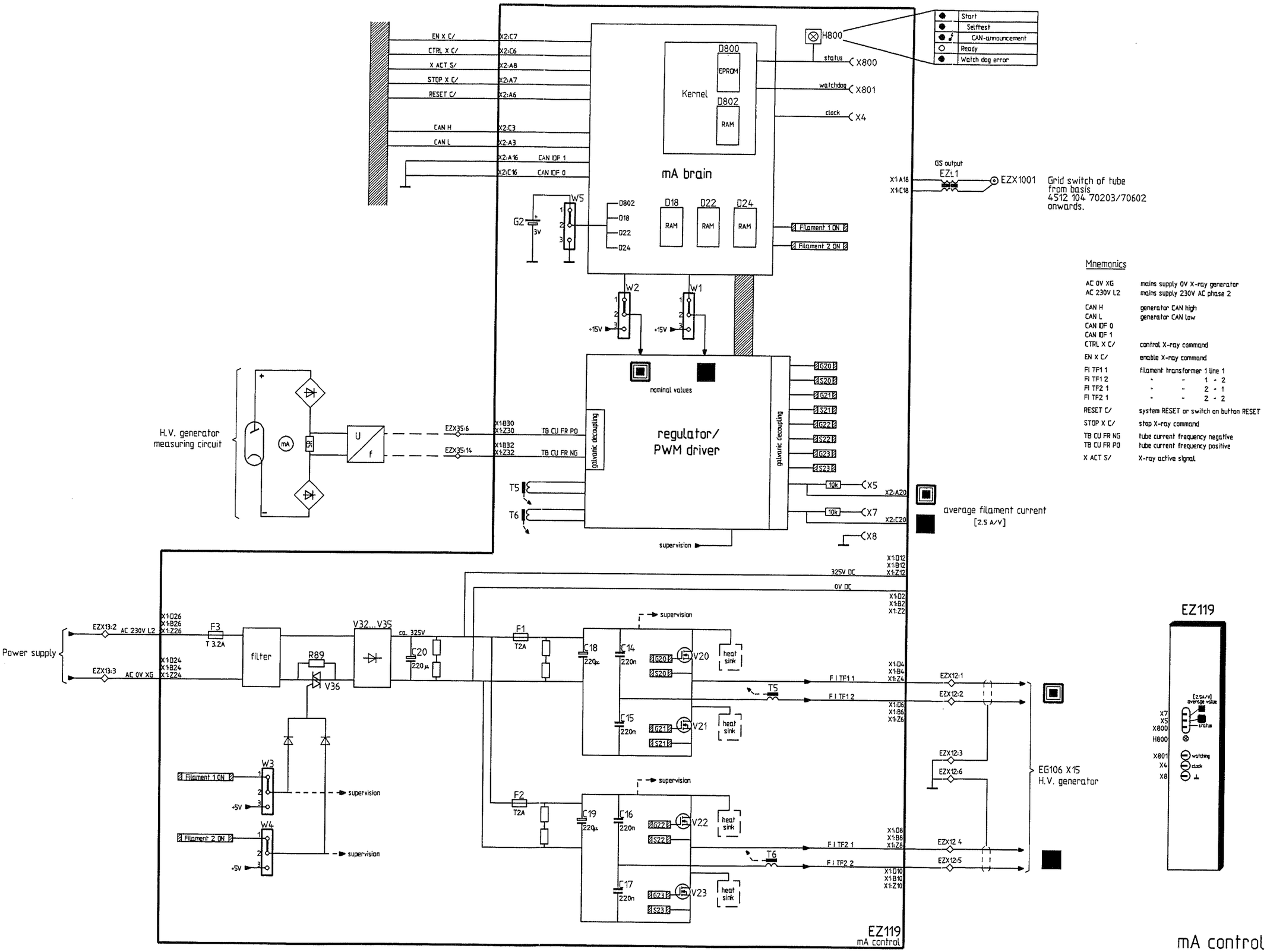
kV power unit
EZQ (option)

EZ130

[20kV/V]

Mnemonics

AV HT	high tension actual value
AV HT AN	high tension actual value anode side
AV CT CA	high tension actual value cathode side
CAN H	generator CAN high active
CAN L	generator CAN low active
CM TH	common for thermal sensor
CM TH SW	common for tube housing switch
CTRL X C/	control X-ray command
CV1 EN	converter power part 1 enable
CV2 EN	converter power part 1 enable
CV1 GND	converter power part 1 ground
CV2 GND	" " " 2 "
CV1 ID	converter power part 1 identification
CV2 ID	" " " 2 "
CV1 GND DL	converter power part 1 ground overload
CV1 DL	converter power part 1 overload
CV2 DL	" " " 2 "
CV1 TM	converter power part 1 temperature
CV2 TM	" " " 2 "
E NG CV1	E value converter power part 1 DC supply negative
E NG CV2	" " " " " 2 " "
E PO CV1	E value converter power part 1 DC supply positive
E PO CV2	" " " " " 2 " "
EN X C/	enable X-ray command
HT AN	high tension anode side actual value
HT AN GND	high tension anode side ground
HT CA	high tension cathode side actual value
HT CA GND	high tension cathode side ground
I1	power part 1
I2	power part 2
I1-1	IGBT1 power part 1
I2-1	IGBT1 power part 2
I1-2	IGBT2 power part 1
I2-2	IGBT2 power part 2
I1-3	IGBT3 power part 1
I2-3	IGBT3 power part 2
I1-4	IGBT4 power part 1
I2-4	IGBT4 power part 2
PW ON NG	DC supply relay power on -
PW ON PO	DC supply relay power on +
RESET C/	system RESET command
SI PH/	single phase identifier
STOP X C/	stop X-ray command
TB 2/	tube 2
3/	" 3
TB 2 RT/	tube 2
TB 3 RT/	" 3
TH OL	tube housing overload
TH OL SW	tube housing overload switch
TP HT GND	temperature high tension tank ground
TP HT SG	temperature signal high tension tank
X ACT S/	X-ray active signal



A1/A3 95-05-19 Dst.
v00323

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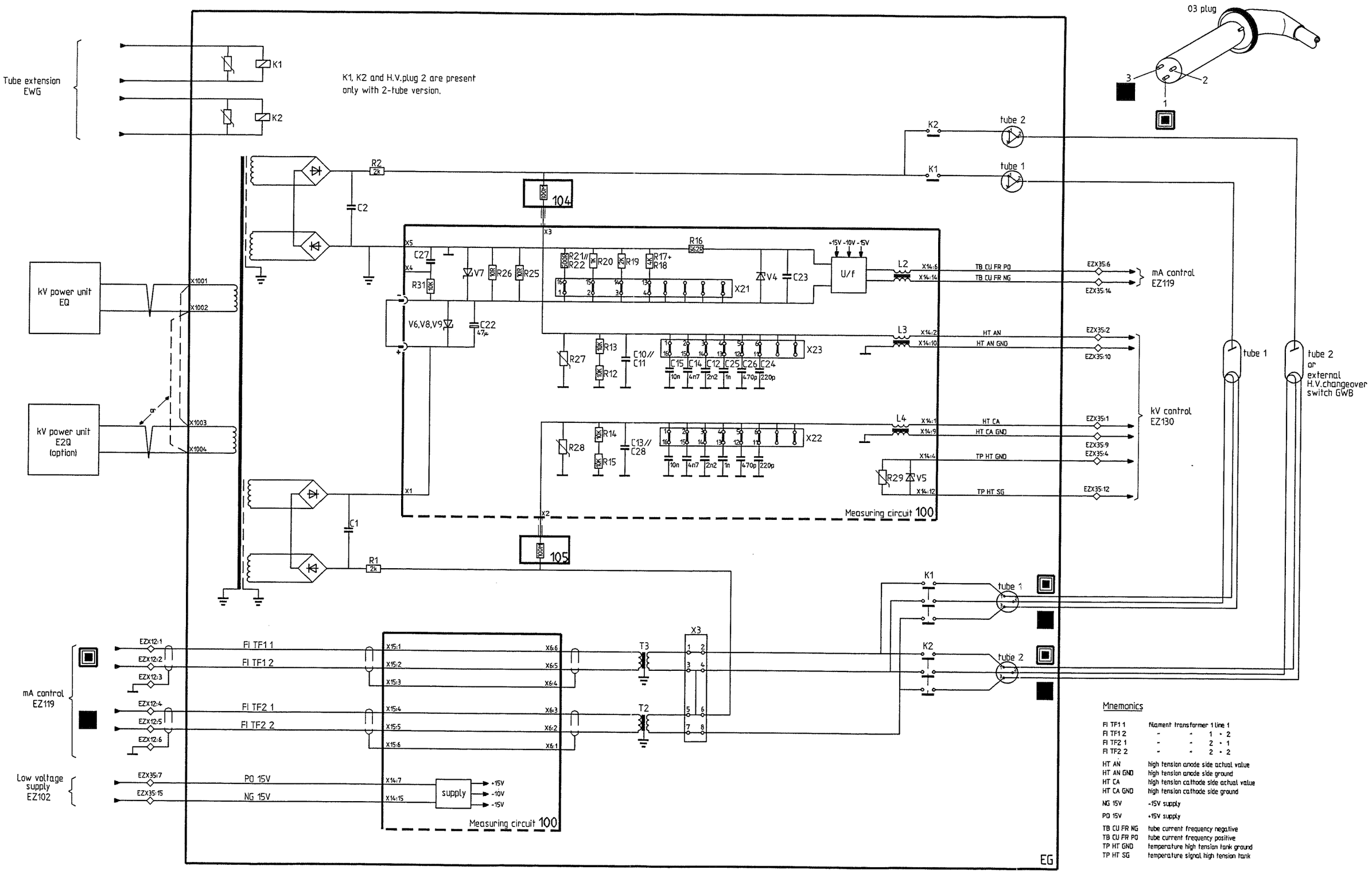
mA control

Z1-4.1



Mnemonics

FI TF1 1	filament transformer 1 line 1
FI TF1 2	" " 1 - 2
FI TF2 1	" " 2 - 1
FI TF2 2	" " 2 - 2
HT AN	high tension anode side actual value
HT AN GND	high tension anode side ground
HT CA	high tension cathode side actual value
HT CA GND	high tension cathode side ground
NG 15V	-15V supply
PO 15V	+15V supply
TB CU FR NG	tube current frequency negative
TB CU FR PO	tube current frequency positive
TP HT GND	temperature high tension tank ground
TP HT SG	temperature signal high tension tank

Note:
In case errors were detected in the tank or on the measuring board, exchange the tank as a whole.

A1/A3 94-06-23 Ost.
V00324

H.V. generator

Z1-4.2

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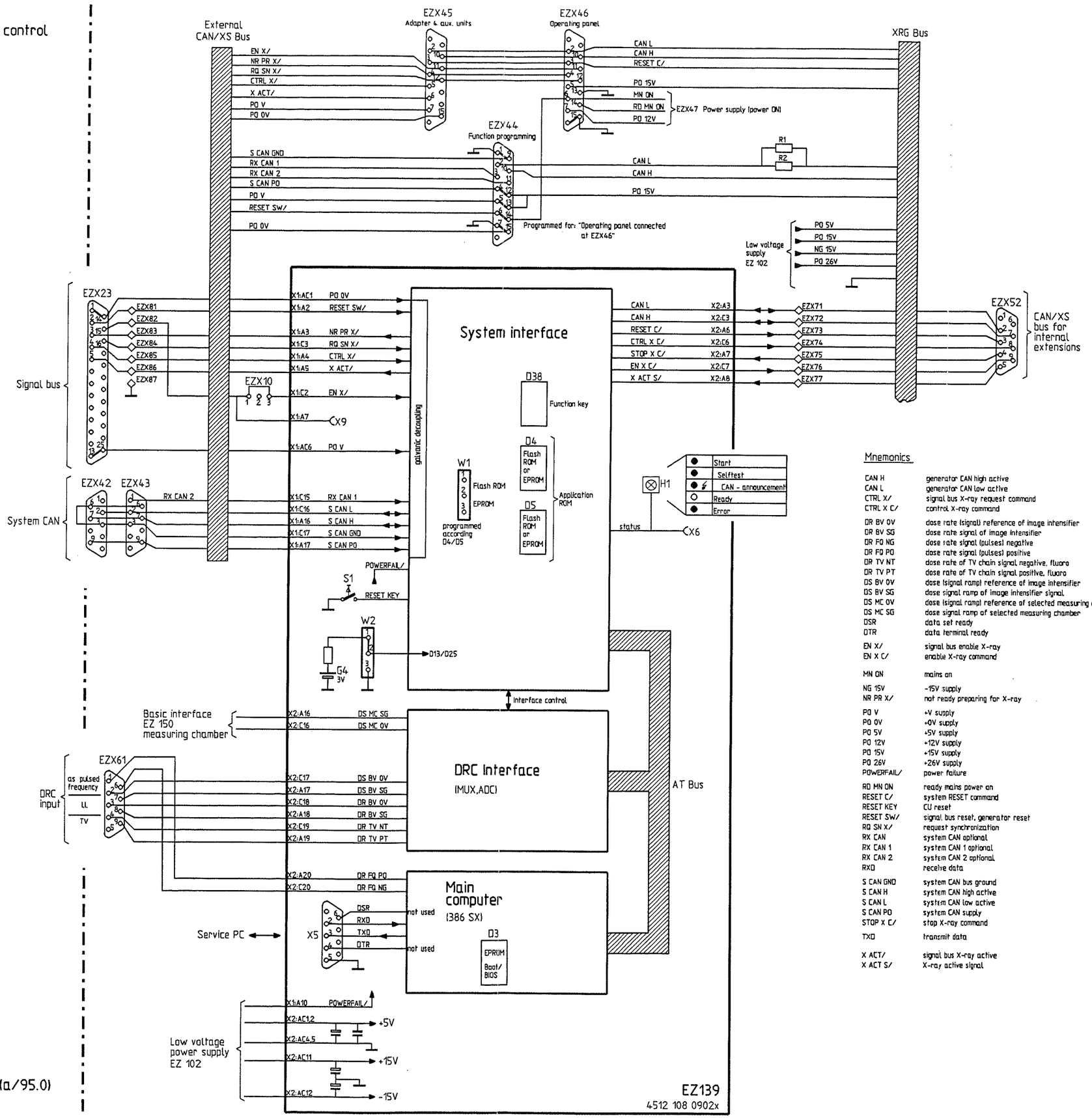
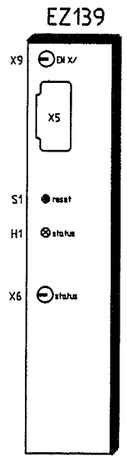


Mnemonics

CAN H	generator CAN high active
CAN L	generator CAN low active
CTRL X/	signal bus X-ray request command
CTRL X C/	control X-ray command
DR BV 0V	dose rate (signal) reference of image intensifier
DR BV SG	dose rate signal of image intensifier
DR FQ NG	dose rate signal (pulses) negative
DR FQ PO	dose rate signal (pulses) positive
DR TV NT	dose rate of TV chain signal negative, fluoro
DR TV PT	dose rate of TV chain signal positive, fluoro
DS BV 0V	dose (signal ramp) reference of image intensifier
DS BV SG	dose signal ramp of image intensifier signal
DS MC 0V	dose (signal ramp) reference of selected measuring chamber
DS MC SG	dose signal ramp of selected measuring chamber
DSR	data set ready
DTR	data terminal ready
EN X/	signal bus enable X-ray
EN X C/	enable X-ray command
MN ON	mains on
NG 15V	-15V supply
NR PR X/	not ready preparing for X-ray
PO V	+V supply
PO 0V	+0V supply
PO 5V	+5V supply
PO 12V	+12V supply
PO 15V	+15V supply
PO 26V	+26V supply
POWERFAIL/	power failure
RD MN ON	ready mains power on
RESET C/	system RESET command
RESET KEY	CU reset
RESET SW/	signal bus reset, generator reset
RQ SN X/	request synchronization
RX CAN	system CAN optional
RX CAN 1	system CAN 1 optional
RX CAN 2	system CAN 2 optional
RXD	receive data
S CAN GND	system CAN bus ground
S CAN H	system CAN high active
S CAN L	system CAN low active
S CAN PO	system CAN supply
STOP X C/	stop X-ray command
TXD	transmit data
X ACT/	signal bus X-ray active
X ACT S/	X-ray active signal



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ua0634

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Central unit

Z1-5.1

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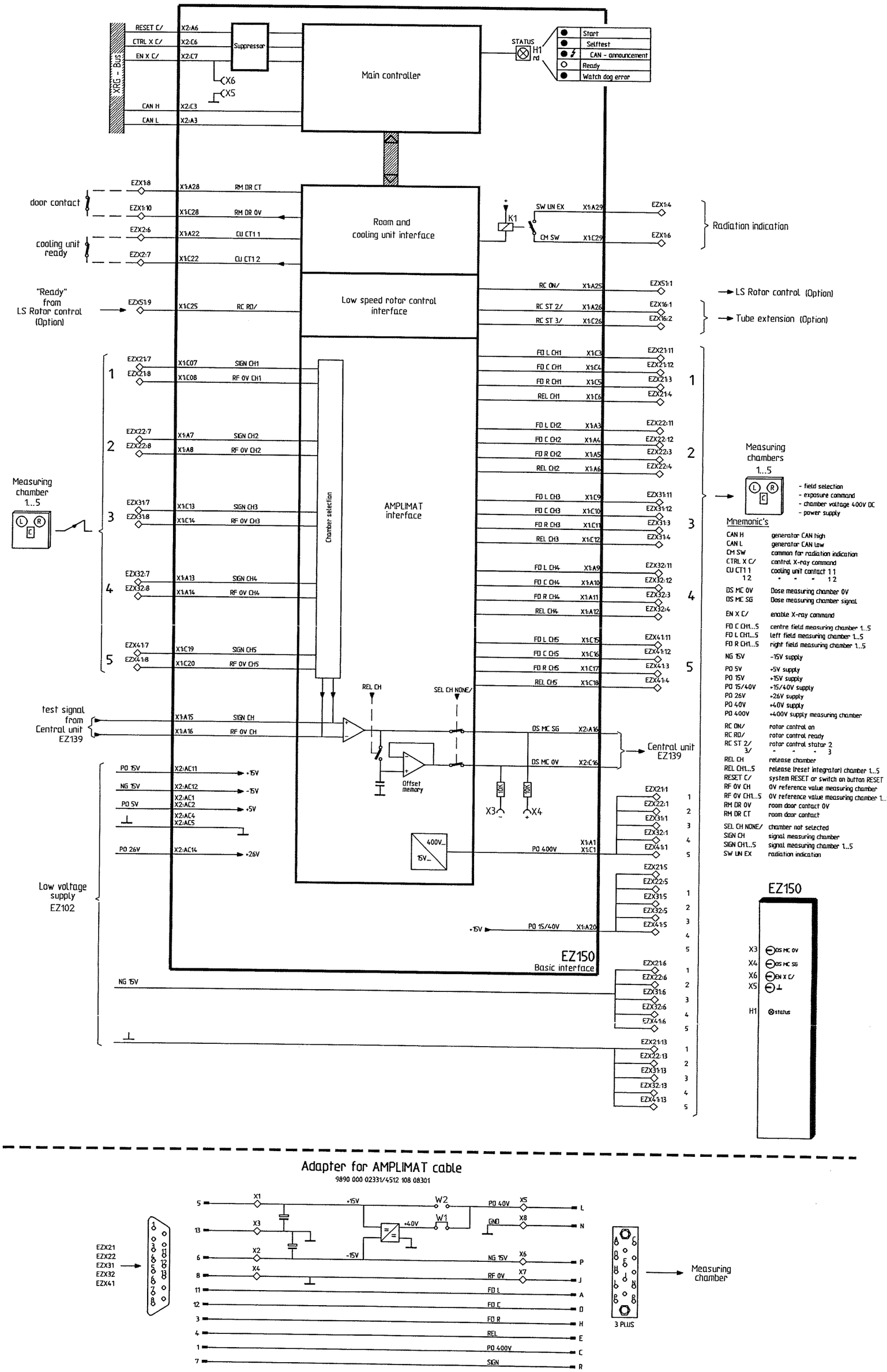
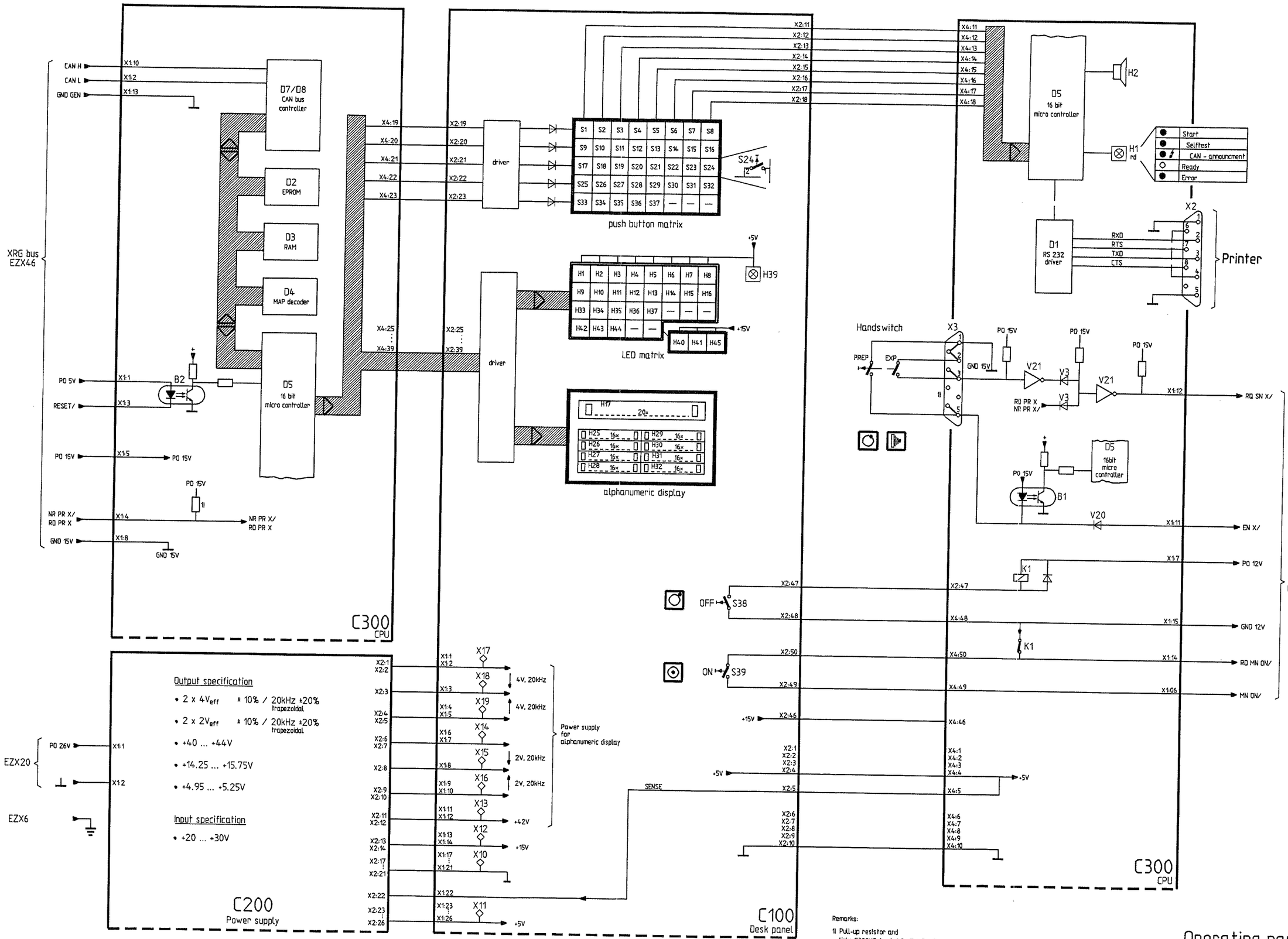
(a/95.0)



Adapter for AMPLIMAT cable

9890 000 02331/4512 108 08301



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v00275

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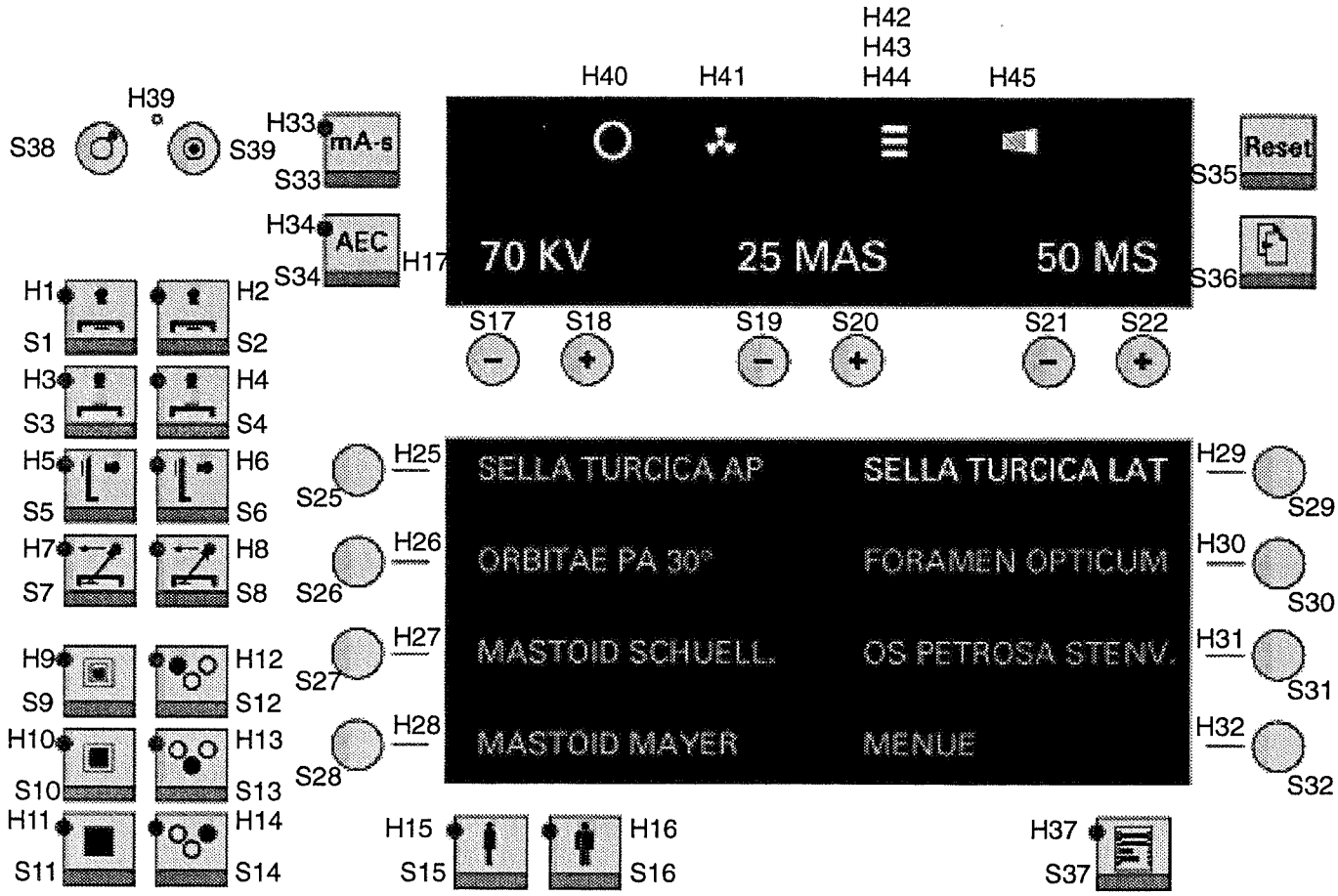
(95.0)

Operating panel C

Z1-11.1



A4 94–06–17 Ost.
OPTIMUS_Z1–11_2

Button and display arrangement

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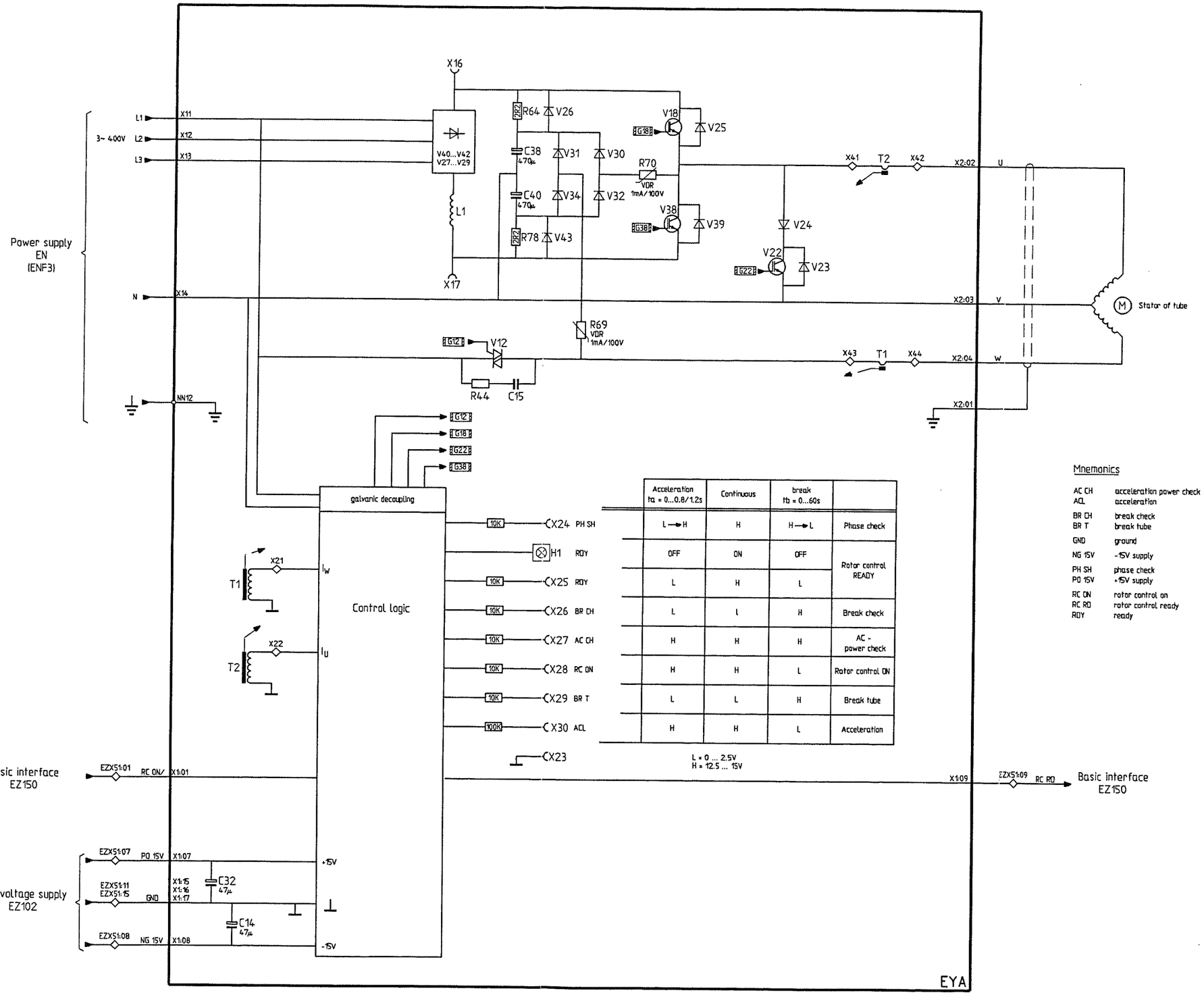

Mnemonics

AC CH	acceleration power check
ACL	acceleration
BR CH	break check
BR T	break tube
GND	ground
NG 15V	-15V supply
PH SH	phase check
PO 15V	+15V supply
RC ON	rotor control on
RC RD	rotor control ready
RDY	ready

Low speed
Rotor control

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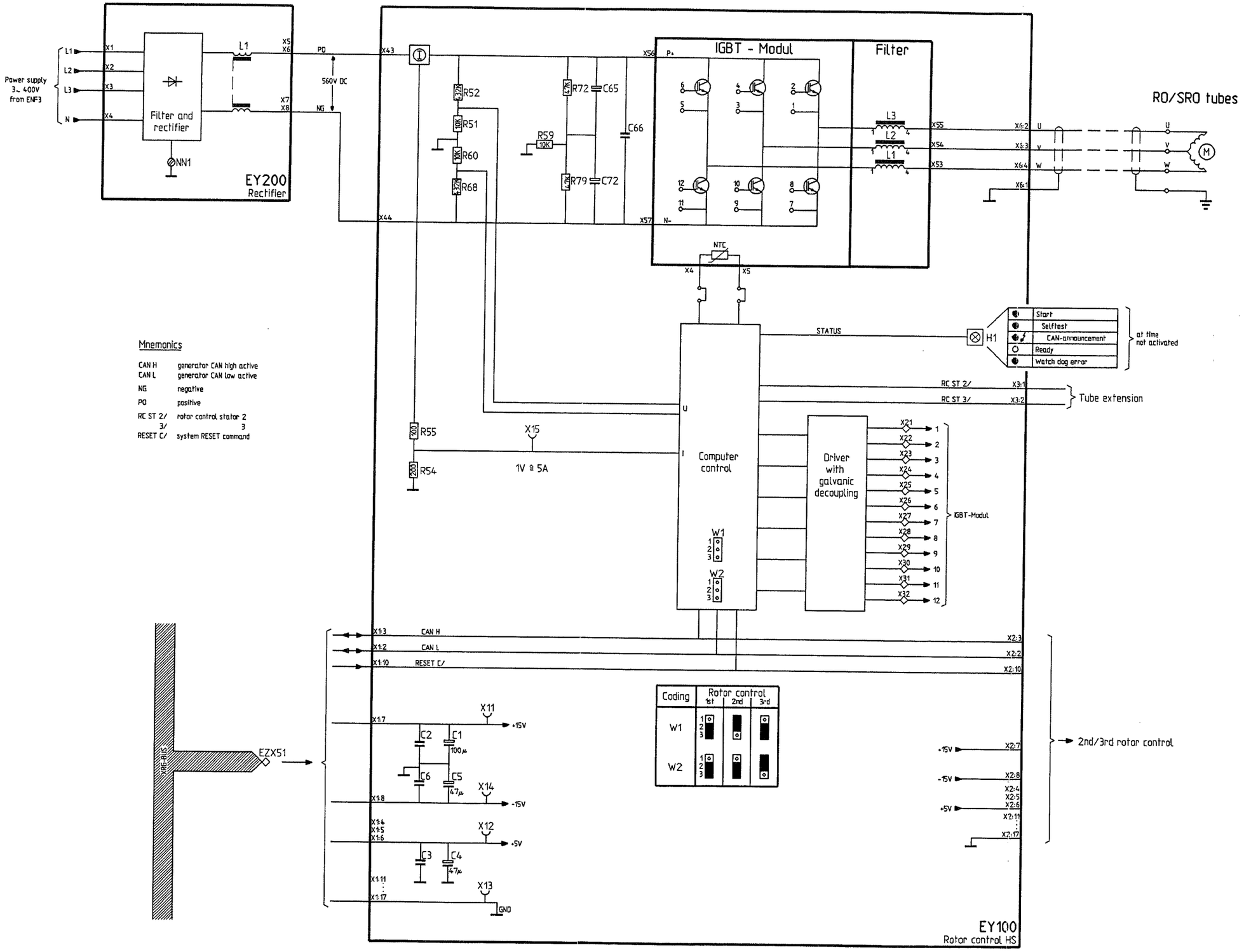

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v00302

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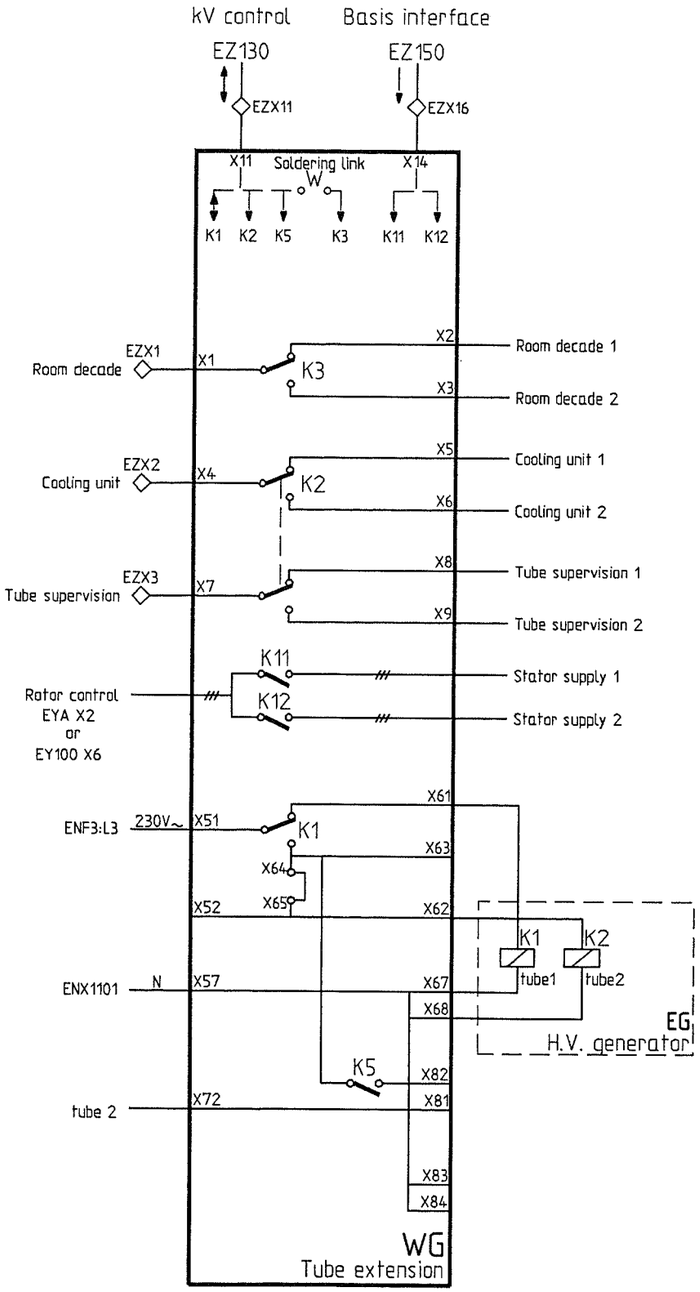
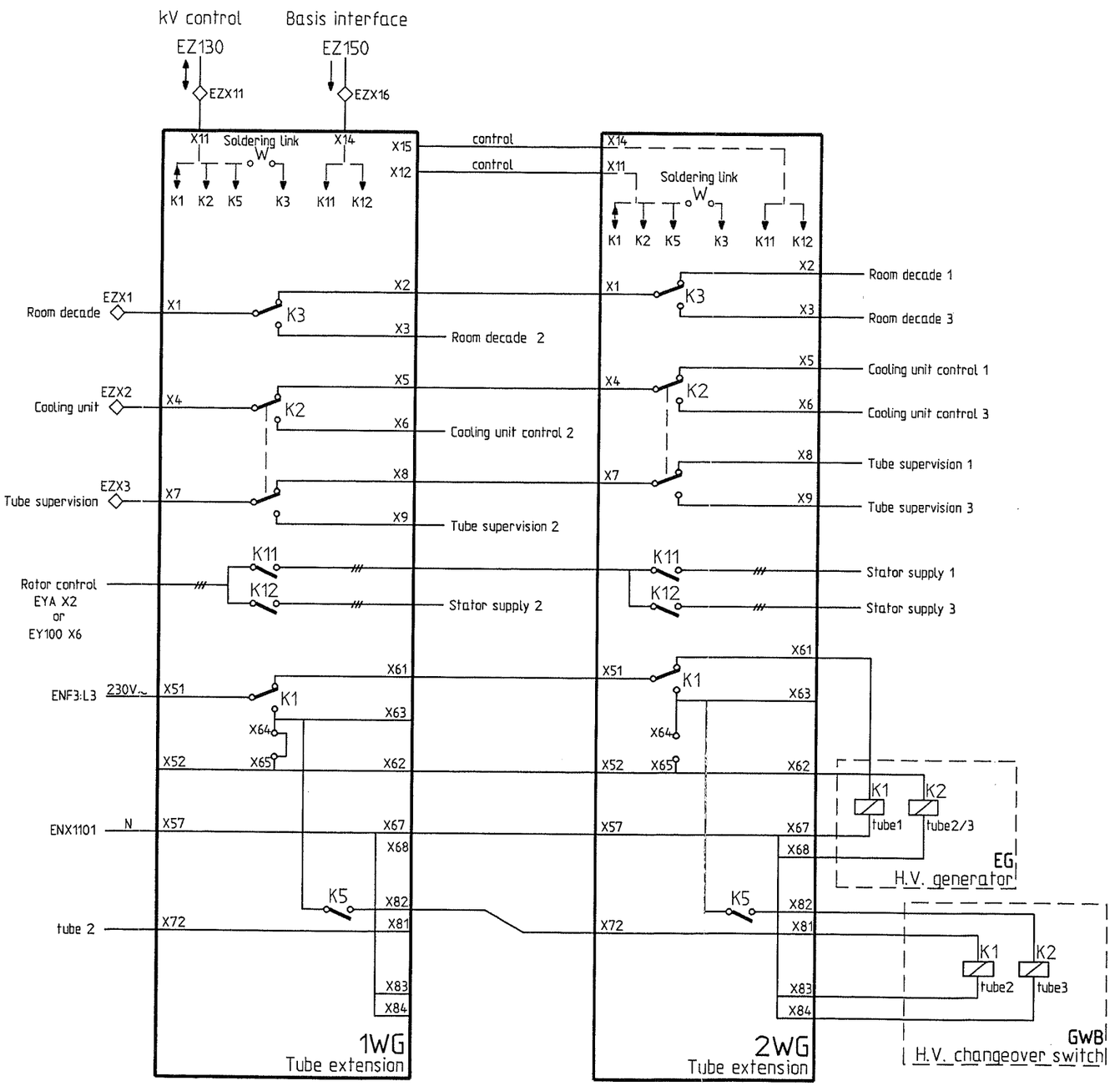
High speed rotor control

Z1-13.2

Tube extension for 2 tubes



Tube extensions for 3 tubes



Tube extension overview

Z1-14.1

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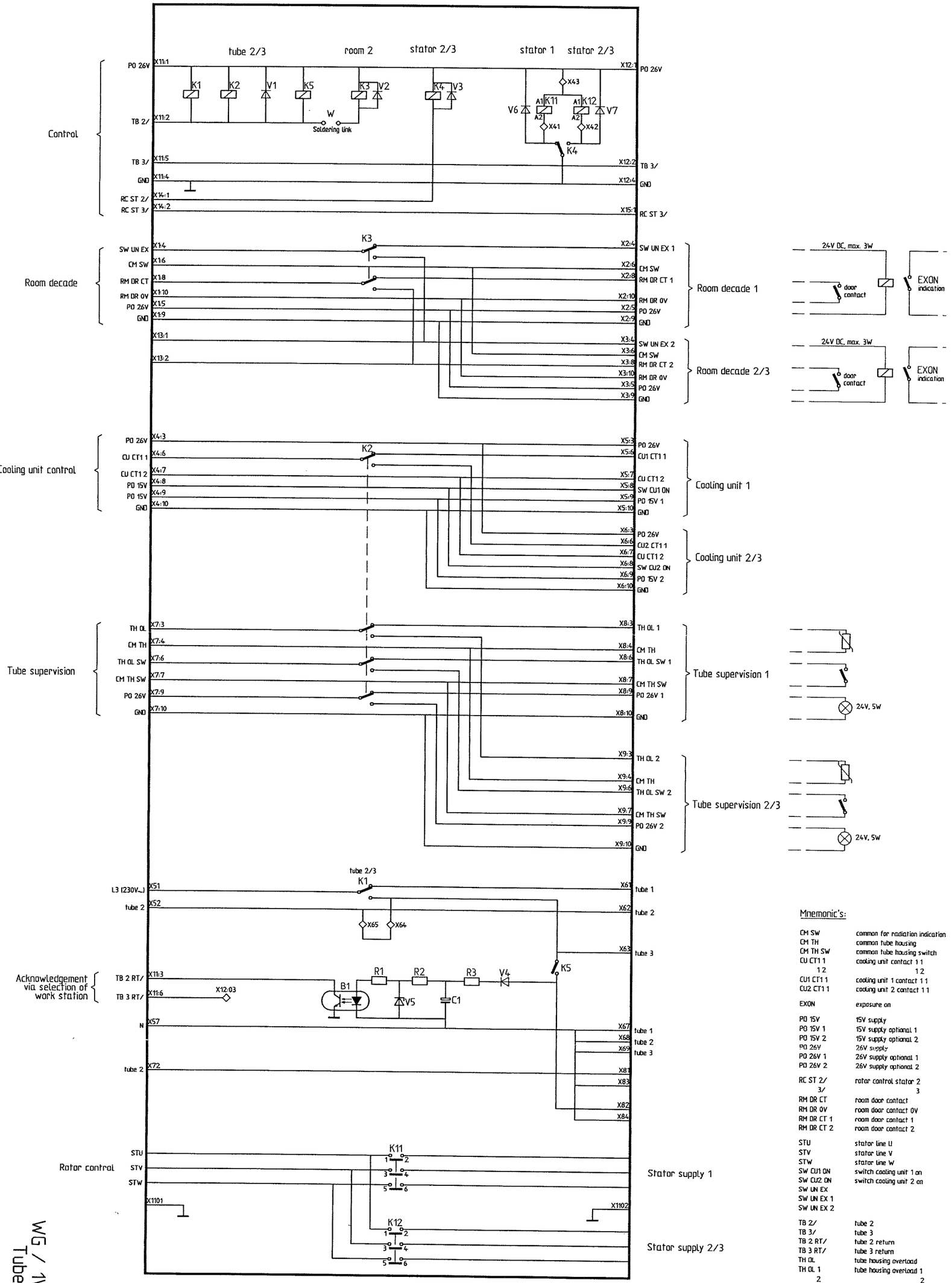

Mnemonic's:

CM SW	common for radiation indication
CM TH	common tube housing
CM TH SW	common tube housing switch
CU CT1 1	cooling unit contact 1 1
1 2	1 2
CU1 CT1 1	cooling unit 1 contact 1 1
CU2 CT1 1	cooling unit 2 contact 1 1
EXON	exposure on
PO 15V	15V supply
PO 15V 1	15V supply optional 1
PO 15V 2	15V supply optional 2
PO 26V	26V supply
PO 26V 1	26V supply optional 1
PO 26V 2	26V supply optional 2
RC ST 2/	rotor control stator 2
3/	3
RM DR CT	room door contact
RM DR 0V	room door contact 0V
RM DR CT 1	room door contact 1
RM DR CT 2	room door contact 2
STU	stator line U
STV	stator line V
STW	stator line W
SW CU1 ON	switch cooling unit 1 on
SW CU2 ON	switch cooling unit 2 on
SW UN EX	
SW UN EX 1	
SW UN EX 2	
TB 2/	tube 2
TB 3/	tube 3
TB 2 RT/	tube 2 return
TB 3 RT/	tube 3 return
TH OL	tube housing overload
TH OL 1	tube housing overload 1
2	2
TH OL SW	tube housing overload switch
TH OL SW 1	tube housing overload switch 1
2	2

OPTIMUS

OPTIMUS
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(95.0)

EZX19 / EZX45 for WA
or
WNX21 / EZX45 for 1WA
or
TWAX42 / TWAX52 for 2WA

X41:1 X41:2 X51
P0 26V

Release 1(5) X1 | Release 2(6) X2 | Release 3(7) X3 | Release 4(8) X4

RQ XG EX — X1:A3
XG RQ EX 1 — X1:C3 — K14
XG RQ EX 2 — X1:A6 — K15
XG RQ EX 3 — X1:A8 — K16
XG RQ EX 4 — X1:A10 — K17
RQ XG PR 1 — X1:A4 — K14
RQ XG PR 2 — X1:C6 — K15
RQ XG PR 3 — X1:C8 — K16
RQ XG PR 4 — X1:C10 — K17
P0 26V RE — X1:AC1
RG DV 1 — X1:C4 — K14
RG DV 2 — X1:A7 — K15
RG DV 3 — X1:A9 — K16
RG DV 4 — X1:A11 — K17
RQ XG FL — X1:A5
GND 2 — X1:AC2
CM EX SW 1 — X1:C5
CM EX SW 2 — X1:C7
CM EX SW 3 — X1:C9
CM EX SW 4 — X1:C11

Tomo

Test PREP S2
Test FLUORO S1
RQ PR/

Release control
(galvanic decoupled)

X2:C25 CTRL X/
X2:A25 RQ SN X/
X2:A24 RQ PR X
NR PR X/
X2:C26 EN X/

+26V +5V → DC/DC → X2:AC14 P0 26V, X2:AC15
+15V → X2:AC27 V15 S P0 V, C75, X2:AC28 GND S P0 0V

K14...K17 Release 1...4
K4...K11 TO PG 1...8
K12 TO PG SL

I/O brain

X2:C3 CAN H
X2:A3 CAN L
X2:A6 RESET C/
X2:A21 COD 1 — W1
X2:C21 COD 2 — W2
X2:A22 COD 3 — W3

Function unit	W1	W2	W3
WA = ADAP_a	–	–	–
1WA = ADAP_a	–	–	–
2WA = ADAP_b	x	–	–

Bucky 1(3) X11 | Bucky 2(4) X12 | closed: | opened:

Format contact — SW SF CF 1 — X1:A18, SW SF CF 2 — X1:A20
Tomo mode — SL XG TO — X1:C18
Tomo ready — SW TO 1 — X1:A19, SW TO 2 — X1:C20
Bucky ready — SW BU 1 — X1:C19, SW BU 2 — X1:A21

Bidirectional I/O interface

status — H1

- Start
- Selftest
- CAN - announcement
- Ready
- Error

CAN/XS bus

X13 X14

EXON — EX ON — X2:A9, IT OV — X2:C9

10R

EXON Interface Logic

RQ PR/

X2:C24 X ACT/

P0 26V
W11 W12 W13
P0 26V RE GND 2
X42:1 X42:2 X52
Expansions

Tomo times X21

SL TO TM 1 — X1:A24
SL TO TM 2 — X1:C24
SL TO TM 3 — X1:A25
SL TO TM 4 — X1:C25
SL TO TM 5 — X1:A26
SL TO TM 6 — X1:C26
SL TO TM 7 — X1:A27
SL TO TM 8 — X1:C27

Tomo trajectories X22

TO PG 1 — X1:A13 — K5
TO PG 2 — X1:C13 — K4
TO PG 3 — X1:A14 — K7
TO PG 4 — X1:C14 — K6
TO PG 5 — X1:A15 — K9
TO PG 6 — X1:C15 — K8
TO PG 7 — X1:A16 — K11
TO PG 8 — X1:C16 — K10
TOMO PG — X1:A17
TO PG SL — X1:C17 — K12

Bidirectional I/O interface

External APRT X23

SL PG 1 — X1:A28
SL PG 2 — X1:C28
SL PG 3 — X1:A29
SL PG 4 — X1:C29
SL PG 5 — X1:A30
SL PG 6 — X1:C30
SL PG 7 — X1:A31
SL PG 8 — X1:C31
P0 26V

PTC X24

P0 26V
SL CO 1 — X1:A32
SL CO 2 — X1:C32

Universal I/O interface
102

Mnemonics

CAN H	generator CAN high active
CAN L	generator CAN low active
CM EX SW 1...4	common for exposure switch of registration device
COD1...3	coding
CTRL X/	signal bus X-ray request command
EN X/	signal bus enable X-ray
EX ON	exposure on
GND 2	ground
GND S or P0 0V	signal bus ground
IT OV	emitter 0V exposure on signal
NR PR X/	not ready preparing for X-ray
P0 26V	+26V supply
P0 26V RE	+26V supply reverse
RESET C/	system RESET command
RG DV 1...4	registration device
RQ PR/	request preparation
RQ SN X/	request synchronization
RQ XG EX	request X-ray generator for exposure
RQ XG FL	request X-ray generator for fluoroscopy
RQ XG PR1...4	request X-ray generator for preparation
SL CO 1	select correction 1 (thickness)
SL CO 2	select correction 2 (thickness)
SL PG 1...8	select ext APRT program
SL TO TM 1...8	select tomo time
SL XG TO	select X-ray generator for tomography
SW BU 1	switch bucky 1
SW BU 2	switch bucky 2
SW SF CF 1	switch side field to central field bucky measuring chamber 1
SW SF CF 2	switch side field to central field bucky measuring chamber 2
SW TO 1	switch tomography 1
SW TO 2	switch tomography 2
TOMO PG	tomo mode programmed
TO PG 1...8	tomo program
TO PG SL	tomo program selected
V15 S or P0 V	signal bus +15V supply
X ACT/	signal bus X-ray active
XG RQ EX 1...4	X-ray generator ready for exposure request

WA / 1WA / 2WA
Adaptor 4 auxil. units

Z1-15.1

Wirings

File: OPTIMUS.ZO-a95.0

Cabinet E	Z2- 1.0
Cabinet wiring E, 50 kW	Z2- 1.1
Cabinet wiring E, 65/80/100 kW	Z2- 1.2
Power supply N, 50 kW	Z2- 2.1
Power supply N, 65/80/100 kW	Z2- 2.2
Mains transformer	Z2- 2.3
kV power unit Q/2Q	Z2- 3
Back panel basis rack Z	Z2- 5.1/.2/.3
Low speed rotor control YA	Z2-12
High speed rotor control Y	Z2-13
Tube extension WG	Z2-14.1
Tube extension WG	Z2-14.2
Tube extension 1WG/2WG	Z2-14.3
Adapter 4 auxil.units WA	Z2-15.1

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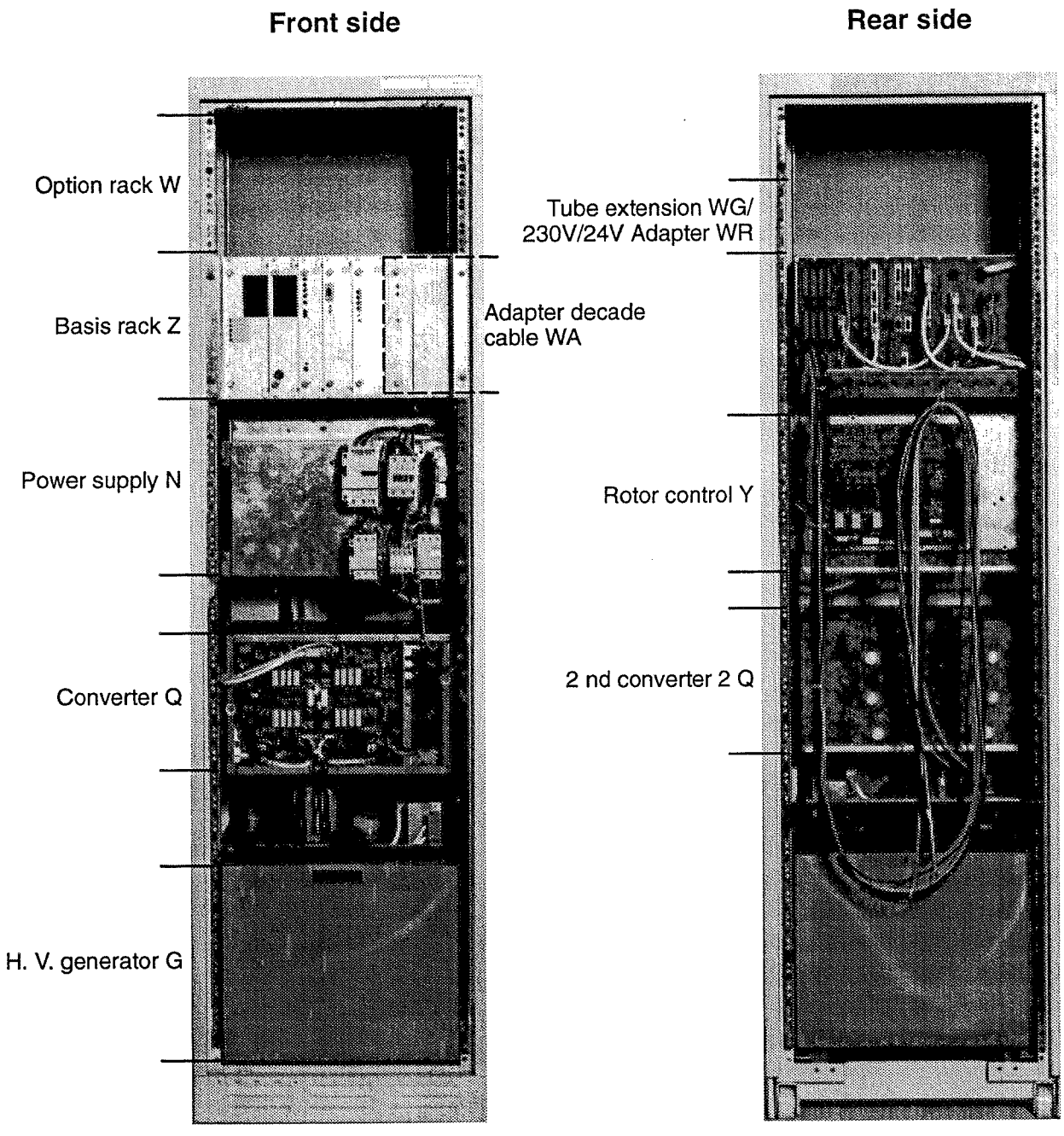

A4 94–10–24 Sie./Ost.
OPTIMUS_Z2_1_0

Cabinet E

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front

Q X1101
Q X1102
Q X1103
N
X1
Z X47
1 3 5
F1
K1
100
Z X13:2
Q200 X11
Z X13:1
Z X13:3
L1 L2
F2
X1102
K2
41
42
F3
Z X24
Z X17
Q200 X13
X1
X2
X1101
X1102
X1103
N K1:1
N K1:3
N K1:5
X11
X13
N K2:42
N K2:41
200
100
Q

rear

Cabinet earth
(E ⏚)
(G X1100)
Z X5

X24
Q100 X1
X12
(G100 X15)
X35
(G100 X14)
X13
N F3
Termination resistor
CAN end
X43
X44
X47
X4
N100 X1
EMOF
X51
(Y/YA100 X1)
X52
Termination resistor
CAN/XS
(no option present)
Programming plug
(desk present)
X17
Q100 X2
(E ⏚)
X5
Z Backpanel

A3/A3 94-10-07 Ost.
v00337

E
Cabinet wiring
50kW

Z2-1.1

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front

Q X1101
Q X1102
Q X1103
2Q X1101
2Q X1102
2Q X1103
N
1 3 5
F1
K1
X1
Z X47
100
Cabinet earth
(E ⏚)
(G X1100)
Z X5
Q200 X11
2Q200 X11
Z X13:1
Z X13:3
Z X13:2
L1 L2
F2
X1102
K2
41
42
F3
Q200 X13
2Q200 X13
Z X24
Z X17
X1
X2
N K1:1
N K1:3
N K1:5
N K2:41
N K2:42
X1101
X1102
X1103
X11
X13
200
100
Q
G

rear

M1
rd
blk
102 X1:D32
102 X2:D8
X24
Q100 X1
X12
(G100 X15)
102
X1
X34
2Q100 X1
X35
X13
N F3
(G100 X14)
D32
M1 rd
Termination resistor
CAN End
X43
X47
EMOF
N100 X1
X4
X2
X44
X51
(Y/YA100 X1)
X52
D8
M1 blk
Termination resistor
CAN/XS
(no option present)
Programming plug
(desk present)
X17
18
Q100 X2
2Q100 X2
(E ⏚)
X5
Z Backpanel

Z X34
Z X18
X1
X2
N K1:1
N K1:3
N K1:5
N K2:41
N K2:42
X1101
X1102
X1103
X11
X13
200
100
2Q

A3/A3 94-12-14 Schr.
u00694

E
Cabinet wiring
65/80/100kW

Z2-1.2

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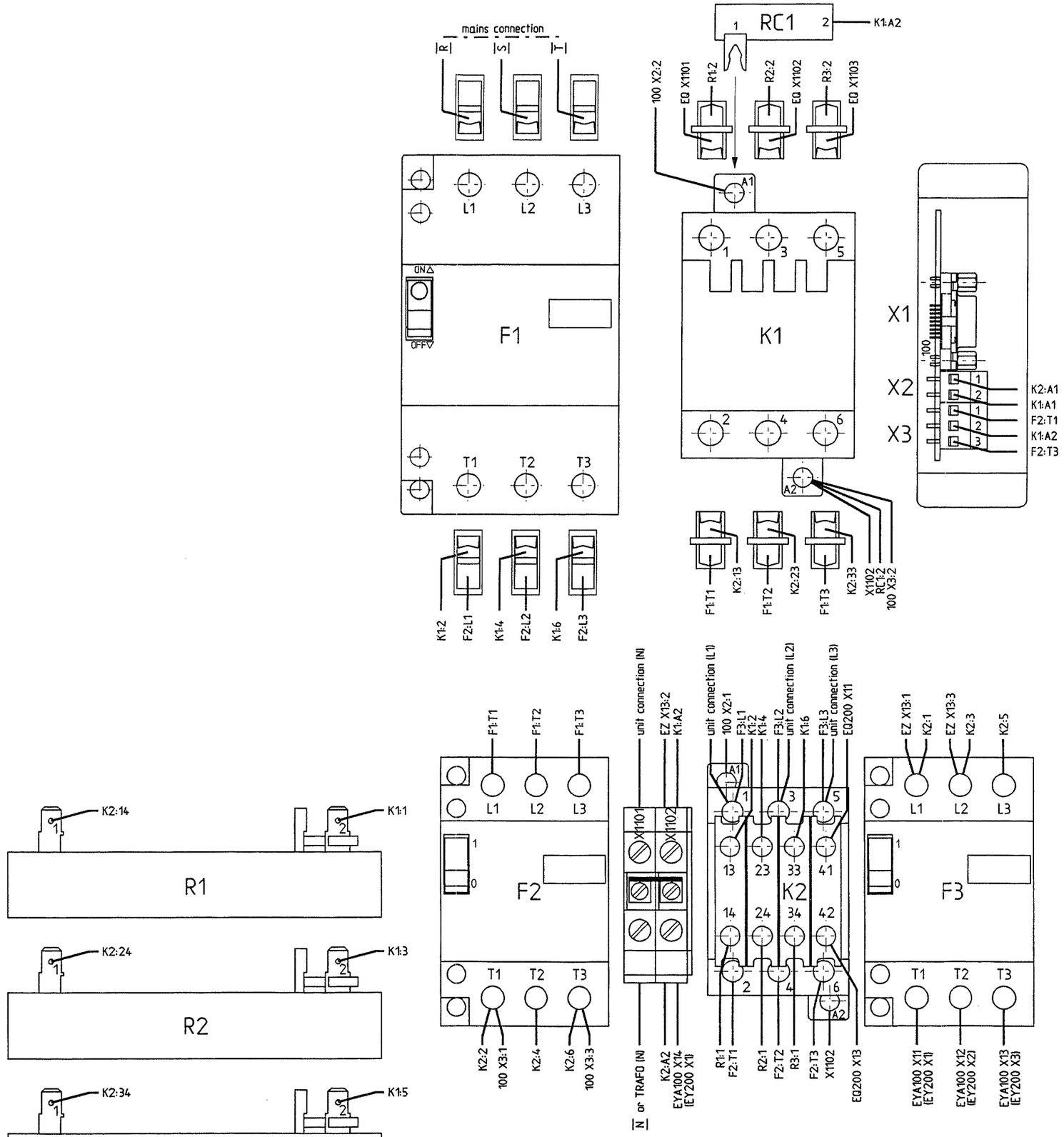

A2/A3 94-10-06 Ost.
v00326

OPTIMUS (94.0)

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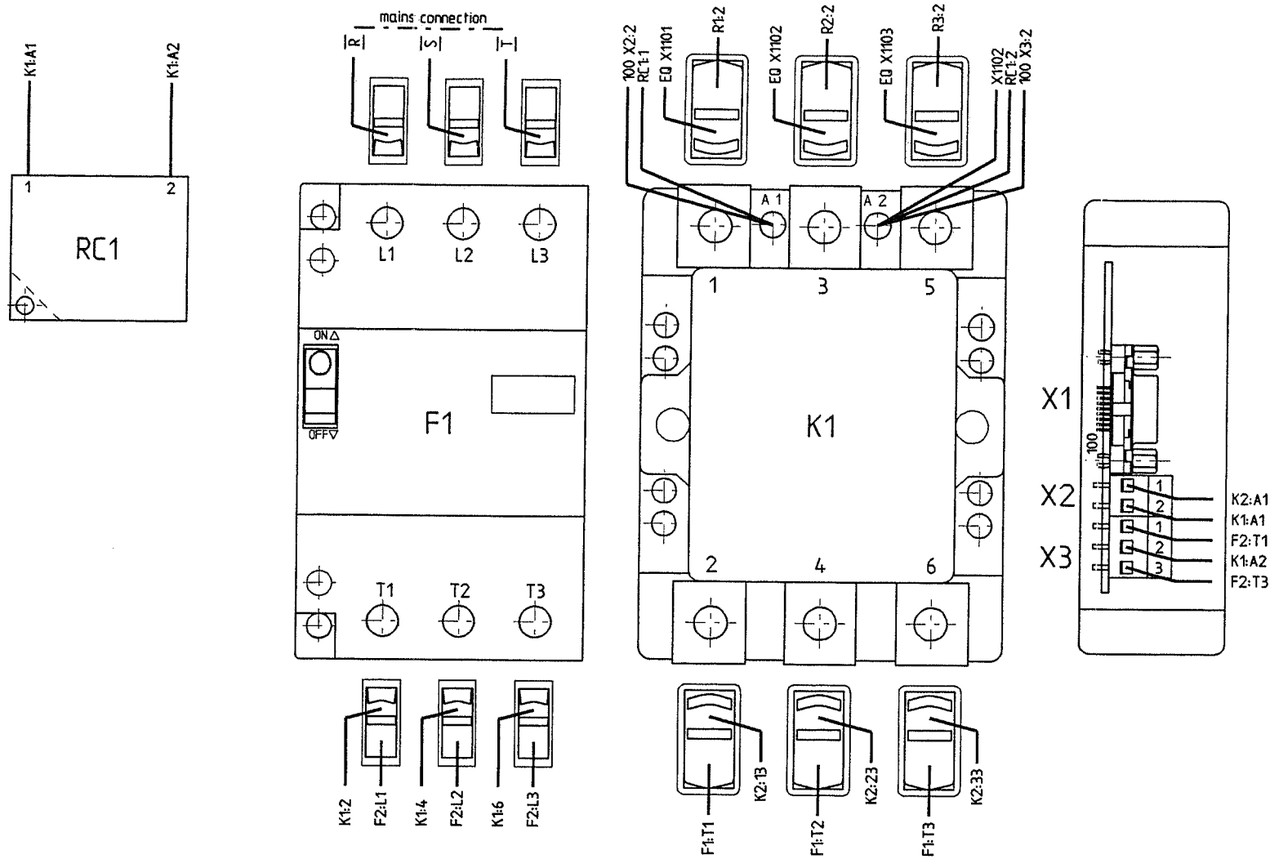
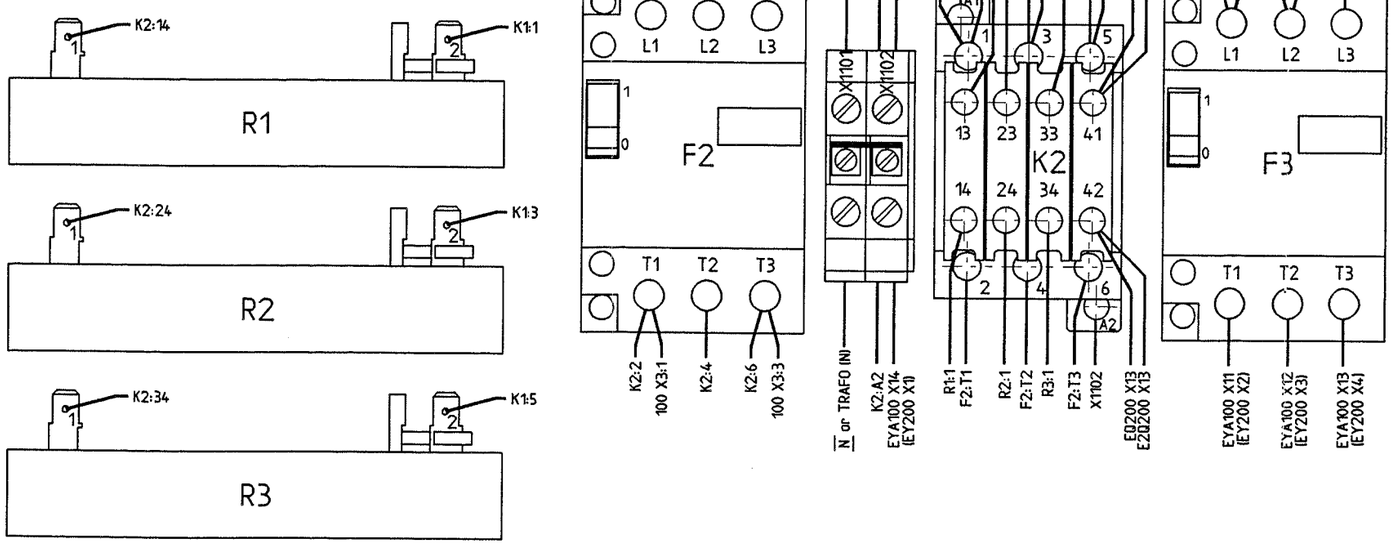
N
Power supply
50kW

Z2-2.1





A3/A3 94-10-06 Ost.
v00338

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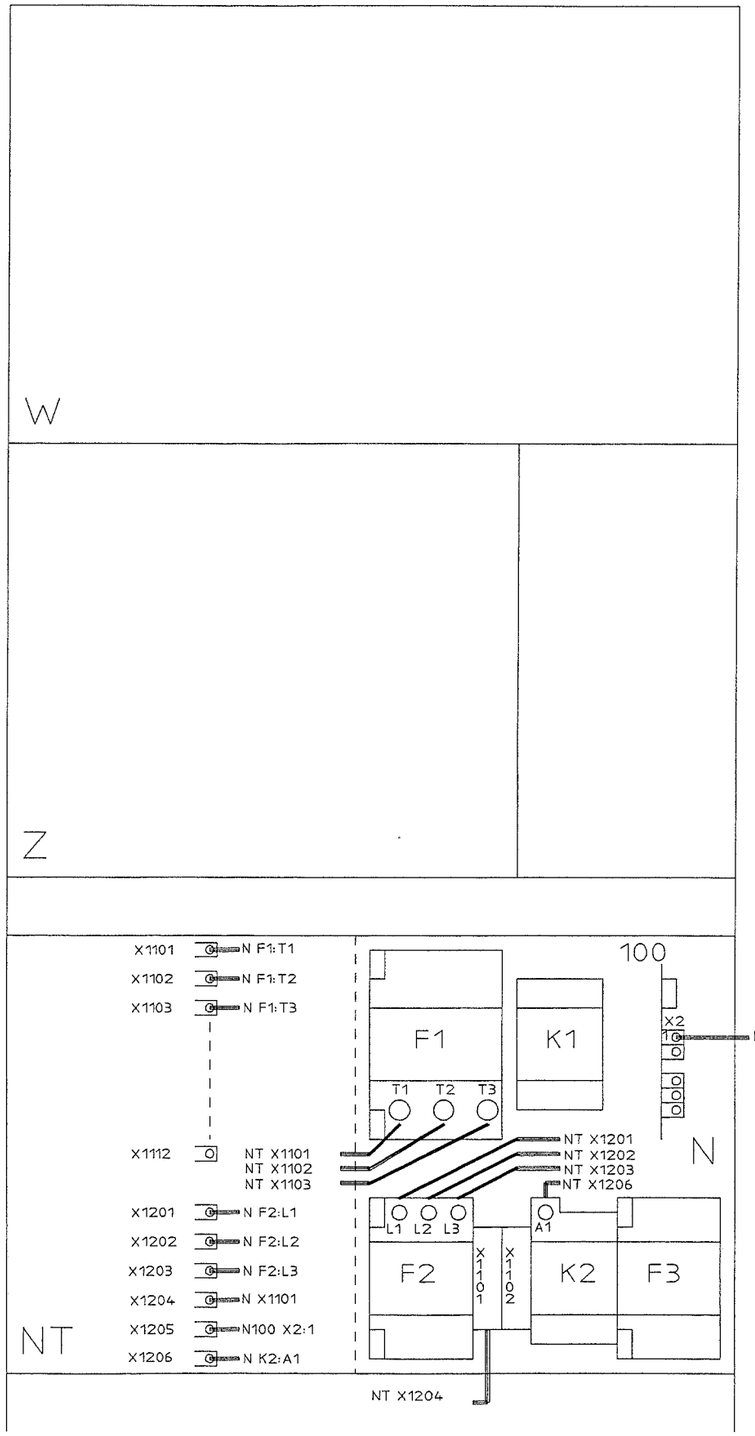
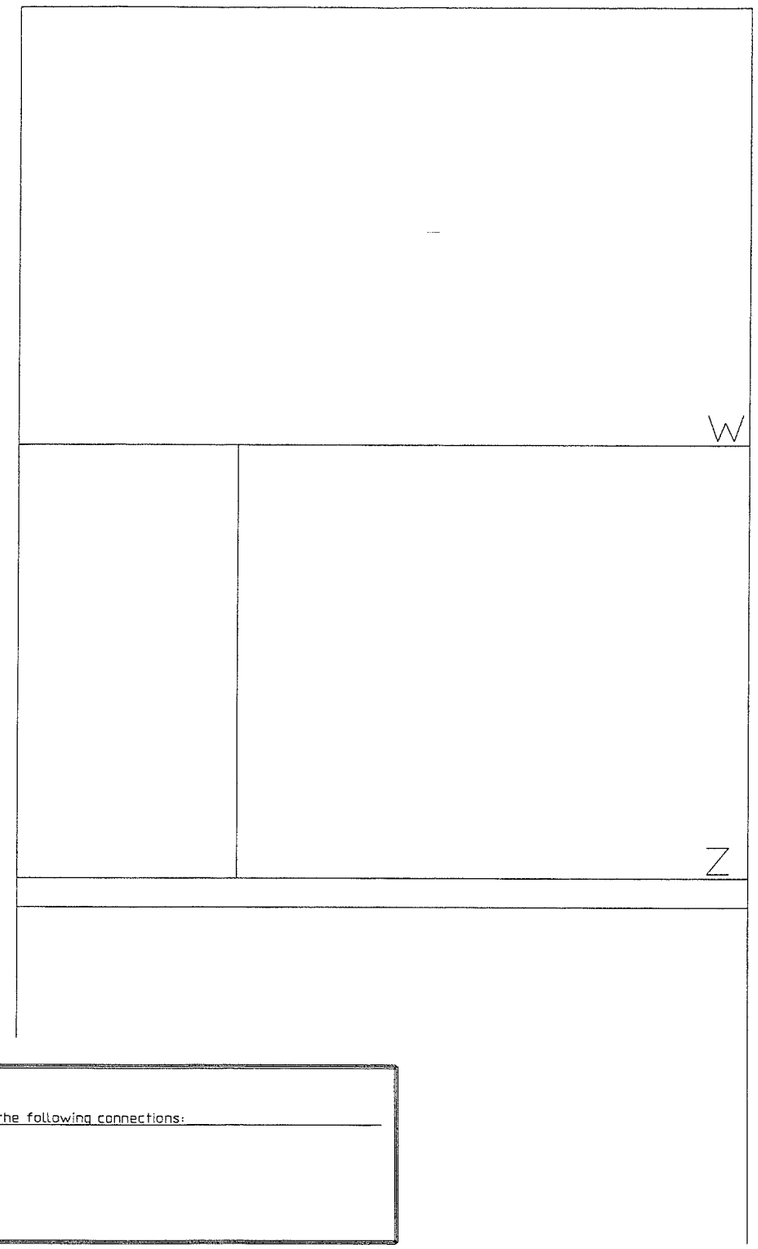
N
Power supply
65/80/100kW

Z2-2.2

front



rear



Caution

Befor installing NT cancel the following connections:

N F1:T1 - N F2:L1
N F1:T2 - N F2:L2
N F1:T3 - N F2:L3
N K2:A1 - N100 X2:1

N X1101 - N

A3/A3 94-10-07 Ost.
v00339

Mains transformer

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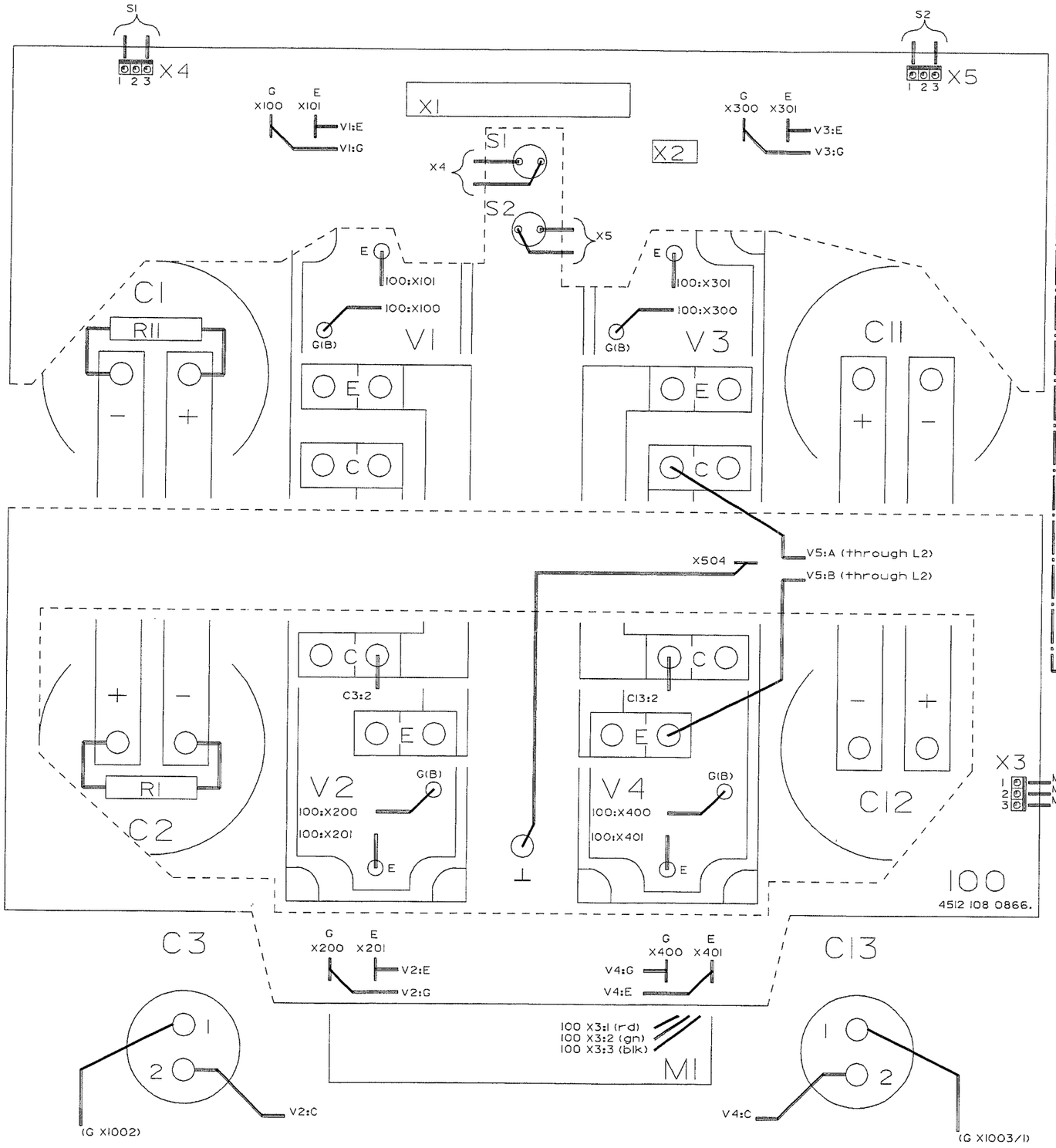

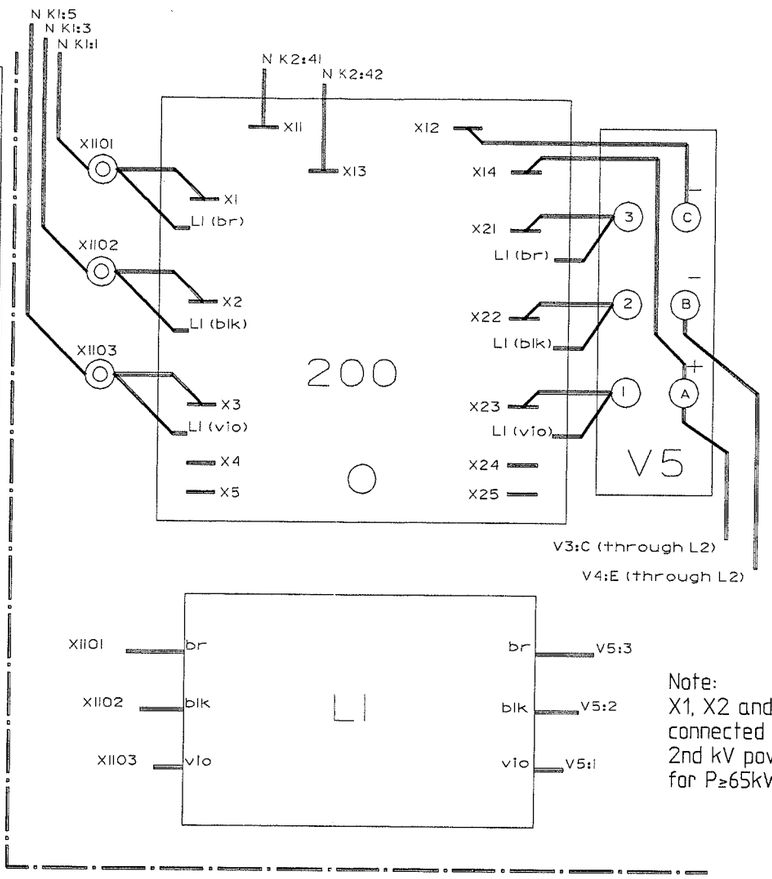

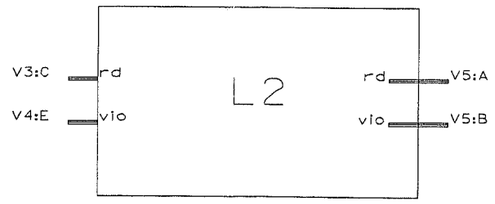

Note:
X1, X2 and X3 not connected if 2nd kV power unit for P≥65kW is present.

A3/A3 95-05-22 Ost.
va0309

Q/2Q
kV power unit

Z2-3

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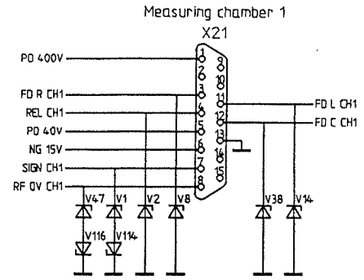

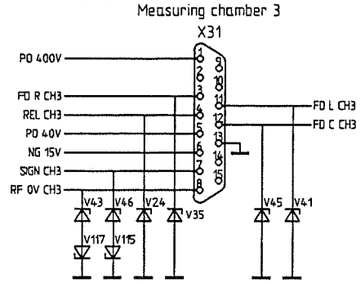

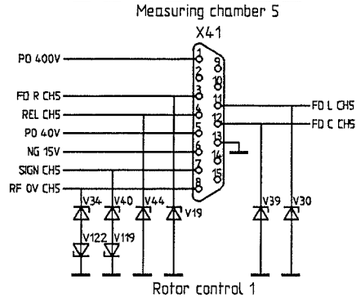

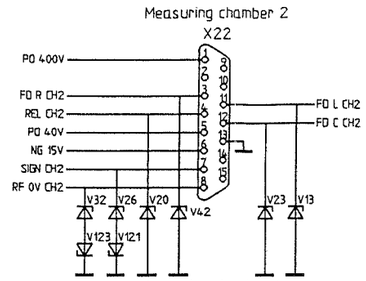

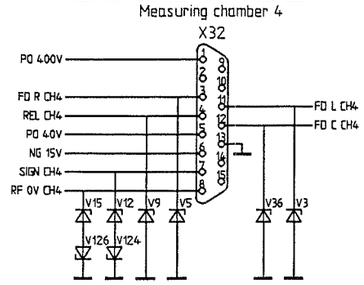

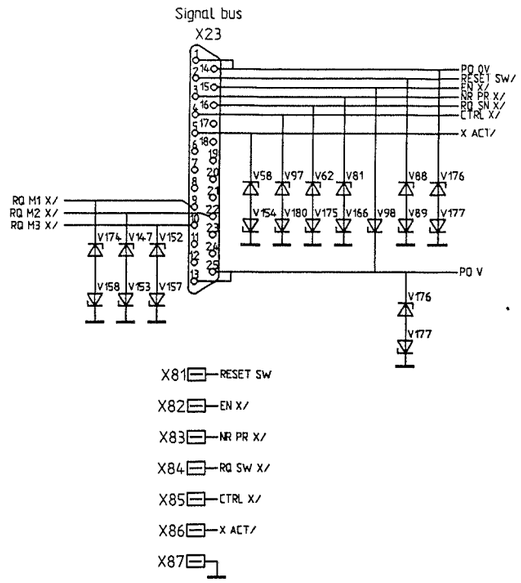

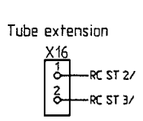

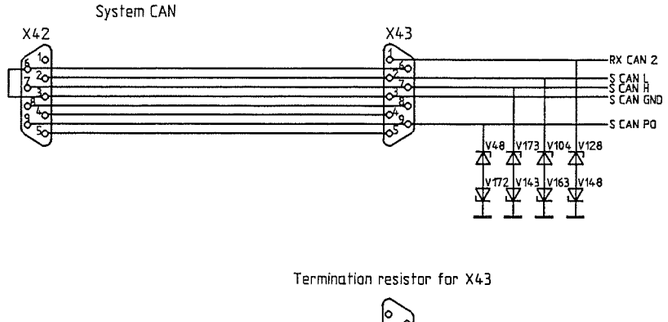

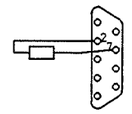

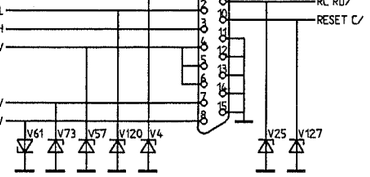

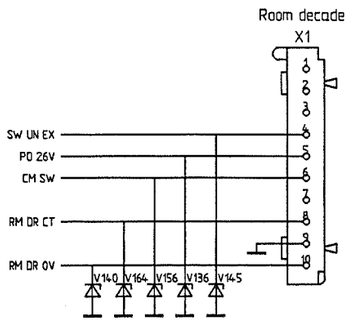

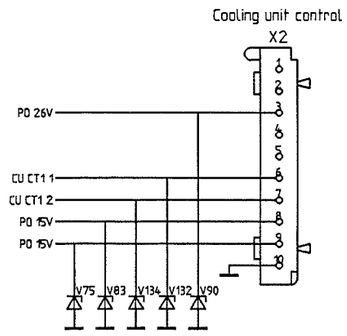

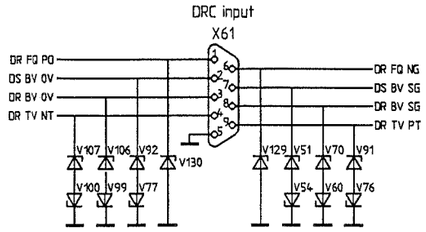

A1/A3 95-05-19 Ost.
va0314

Back panel
Basis rack Z

Z2-5.1

OPTIMUS (a/95.0)

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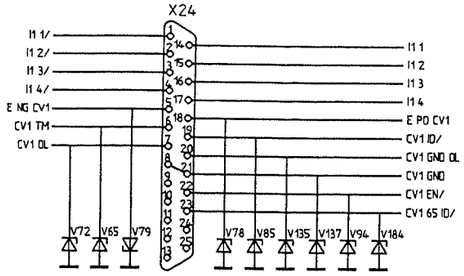
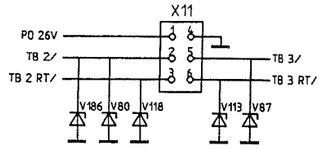
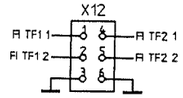
kV power unit EQ



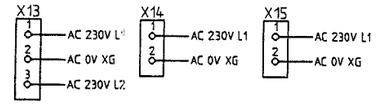
Tube extension



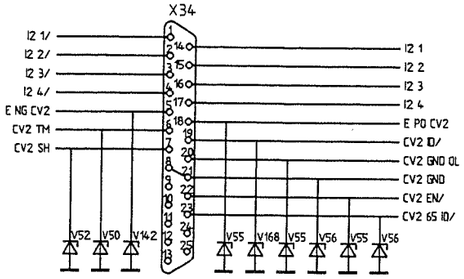
H.V. generator



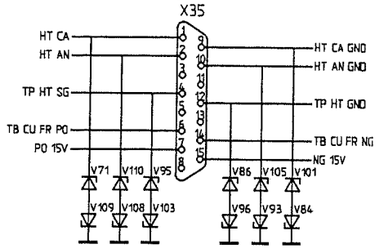
Power supply

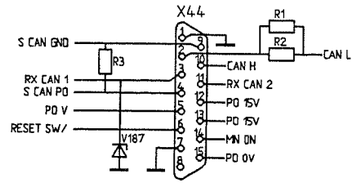


kV power unit E2Q



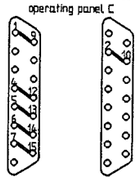
H.V. generator

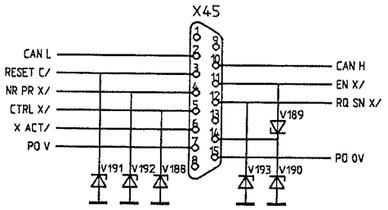




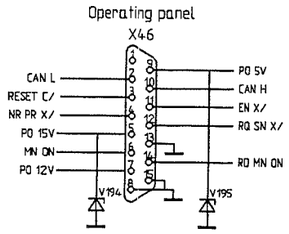
Function programming plug for X44

with / without operating panel C

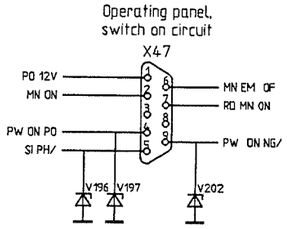




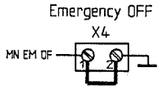
Operating panel



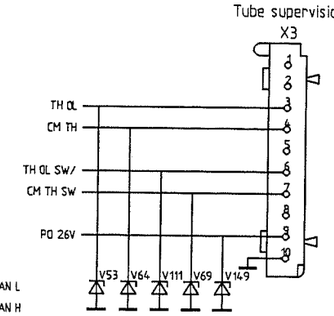
Operating panel, switch on circuit



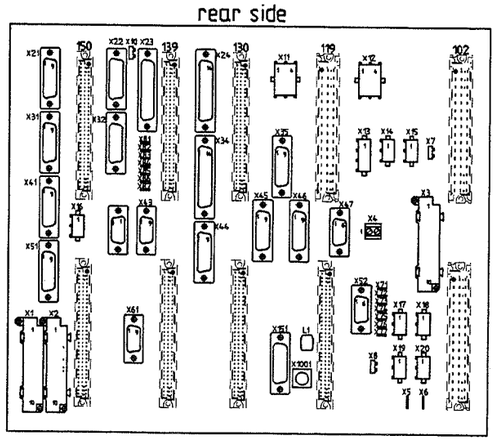
Emergency OFF



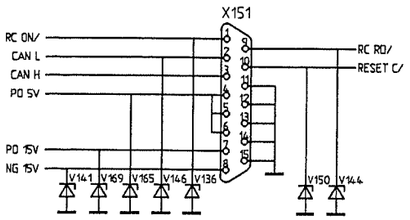
Tube supervision

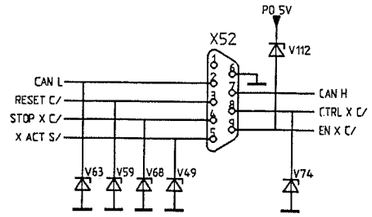


rear side

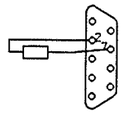


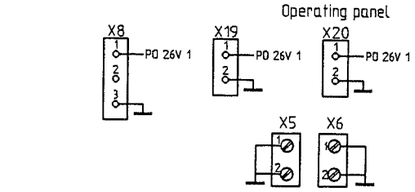
Rotor control 2



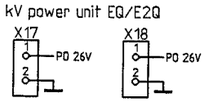


Termination resistor for X52





kV power unit EQ/E2Q



Operating panel

A1/A3 95-05-19 Ost.
va0315

OPTIMUS (a/95.0)

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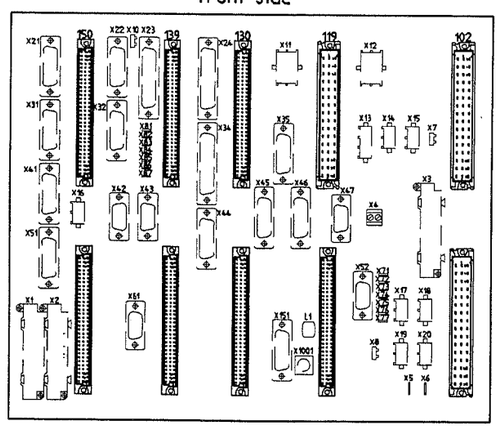
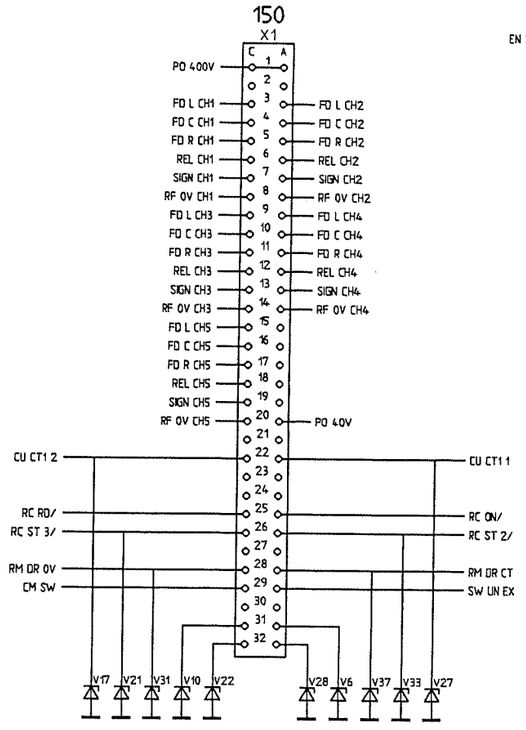
Back panel
Basis rack Z

Z2-5.2

front side



Basic interface

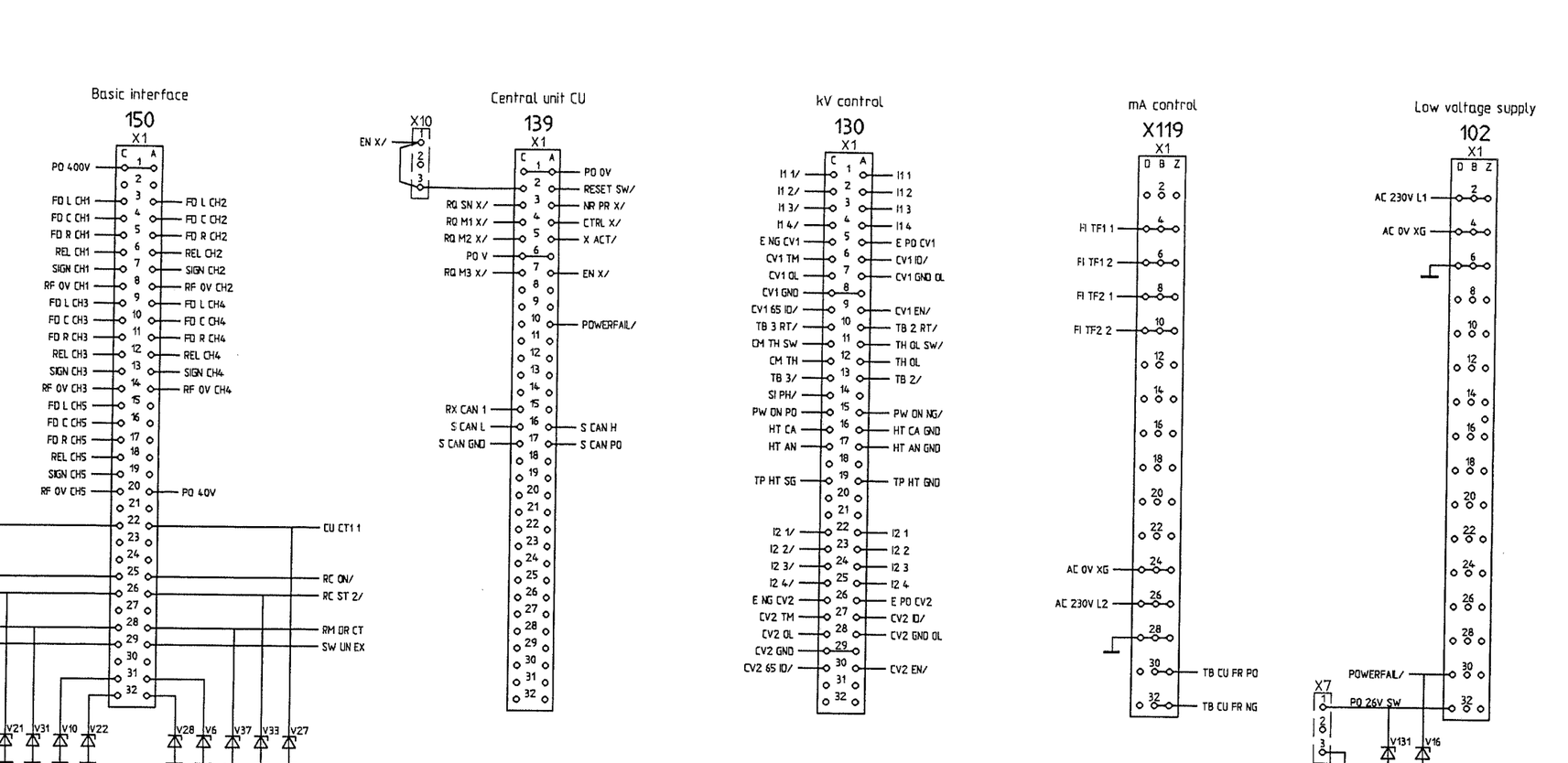


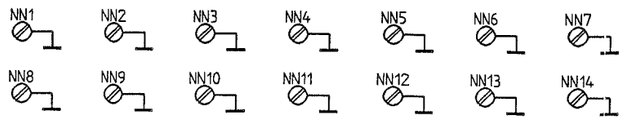
Central unit CU

kV control

mA control

Low voltage supply





A1/A3 95-05-19 Ost.
v00362

OPTIMUS (95.0)

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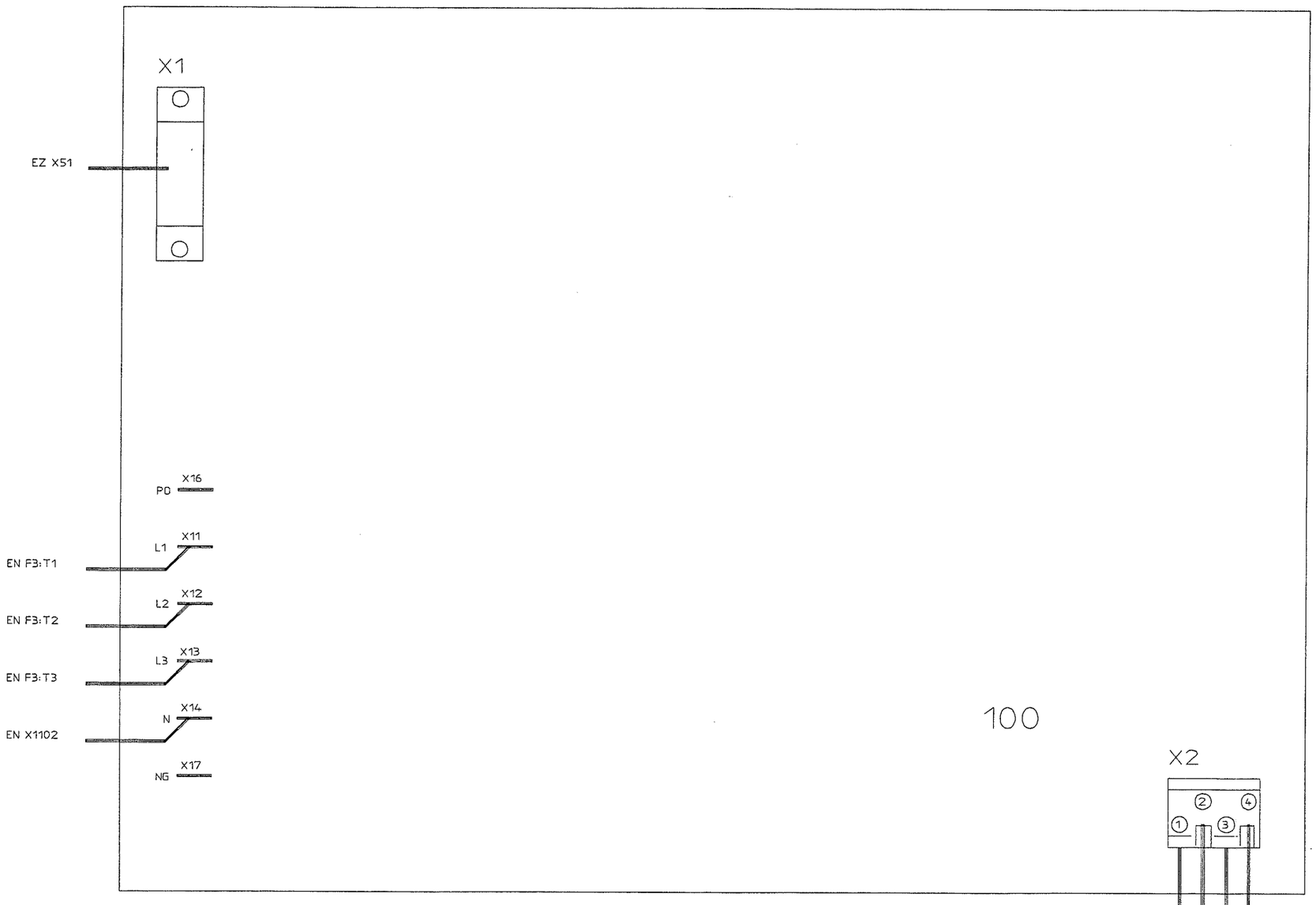
Back panel
Basis rack Z

Z2-5.3



A3/A3 94-10-07 Ost.
v00342

YA
Low speed rotor control

OPTIMUS (94.0)
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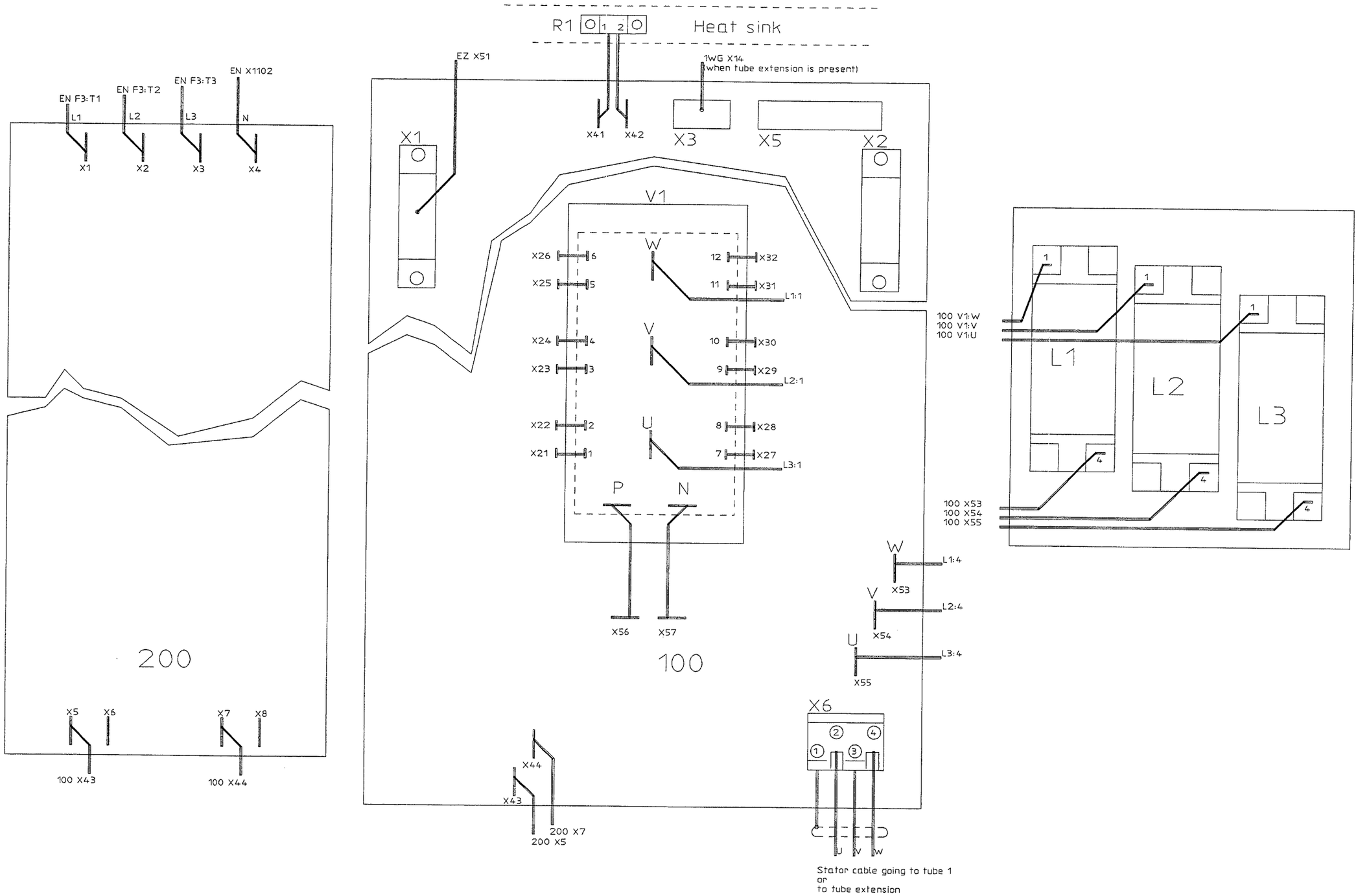

A3/A3 94-10-07 Ost.
v00343

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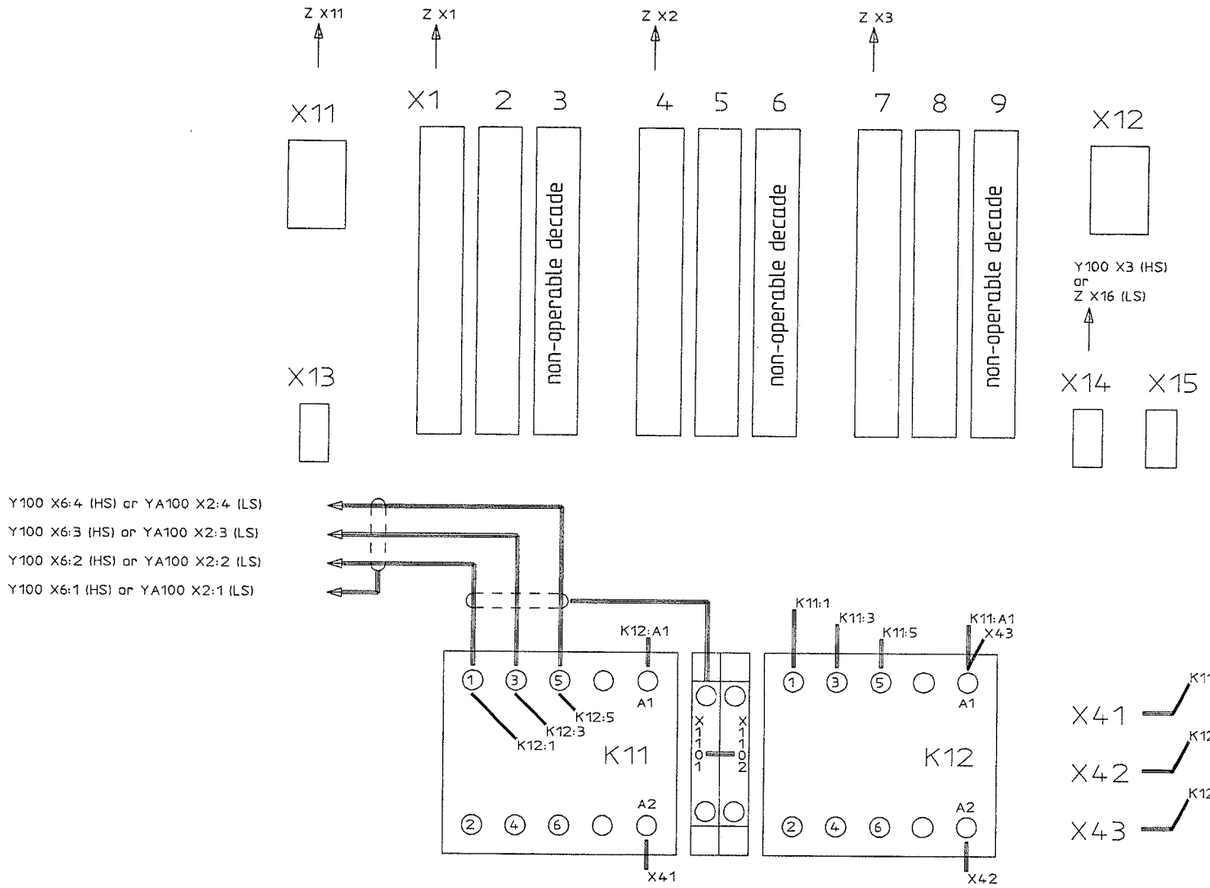
Y
High speed rotor control



A3/A3 94-10-07 Ost.
v00340

OPTIMUS (94.0)
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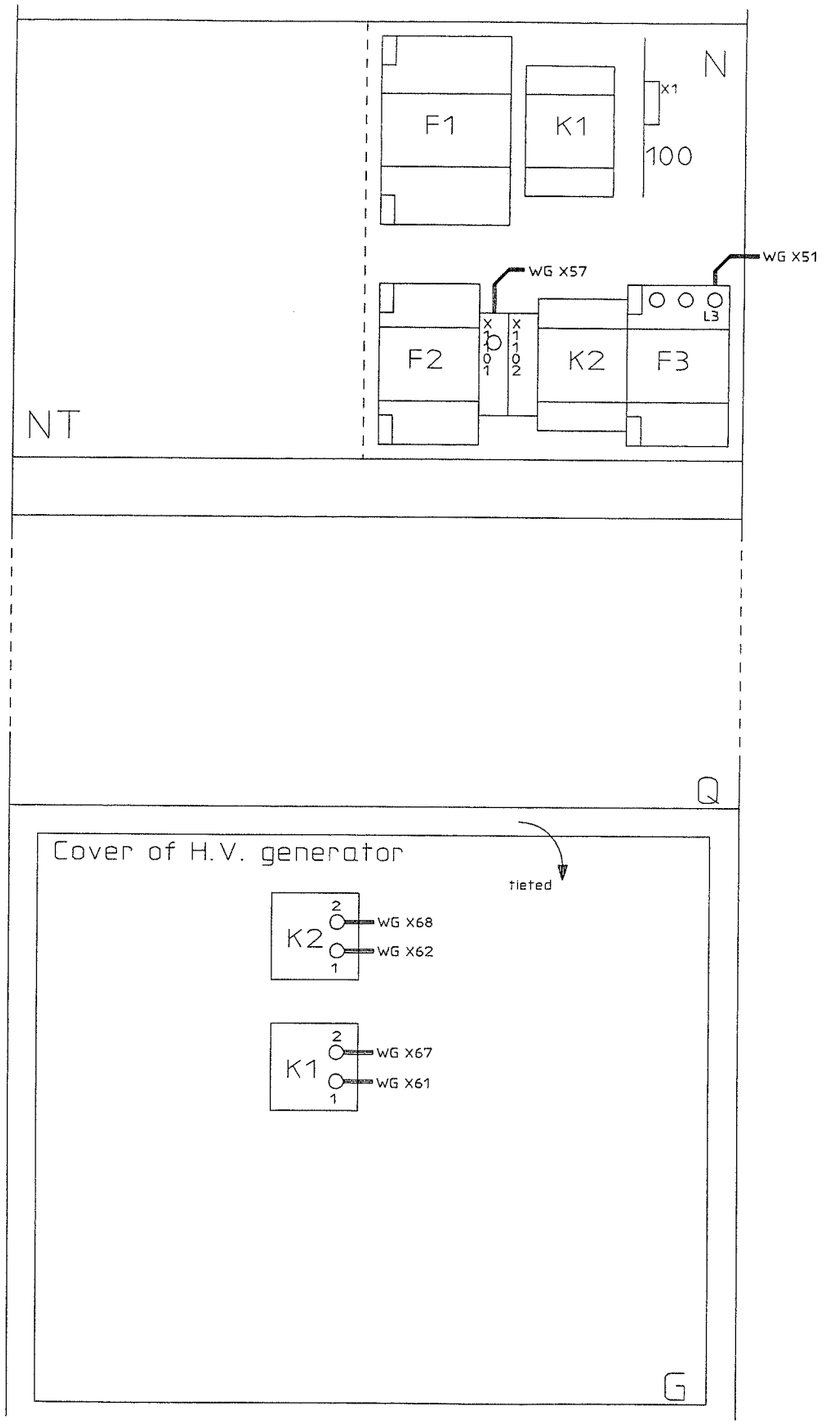
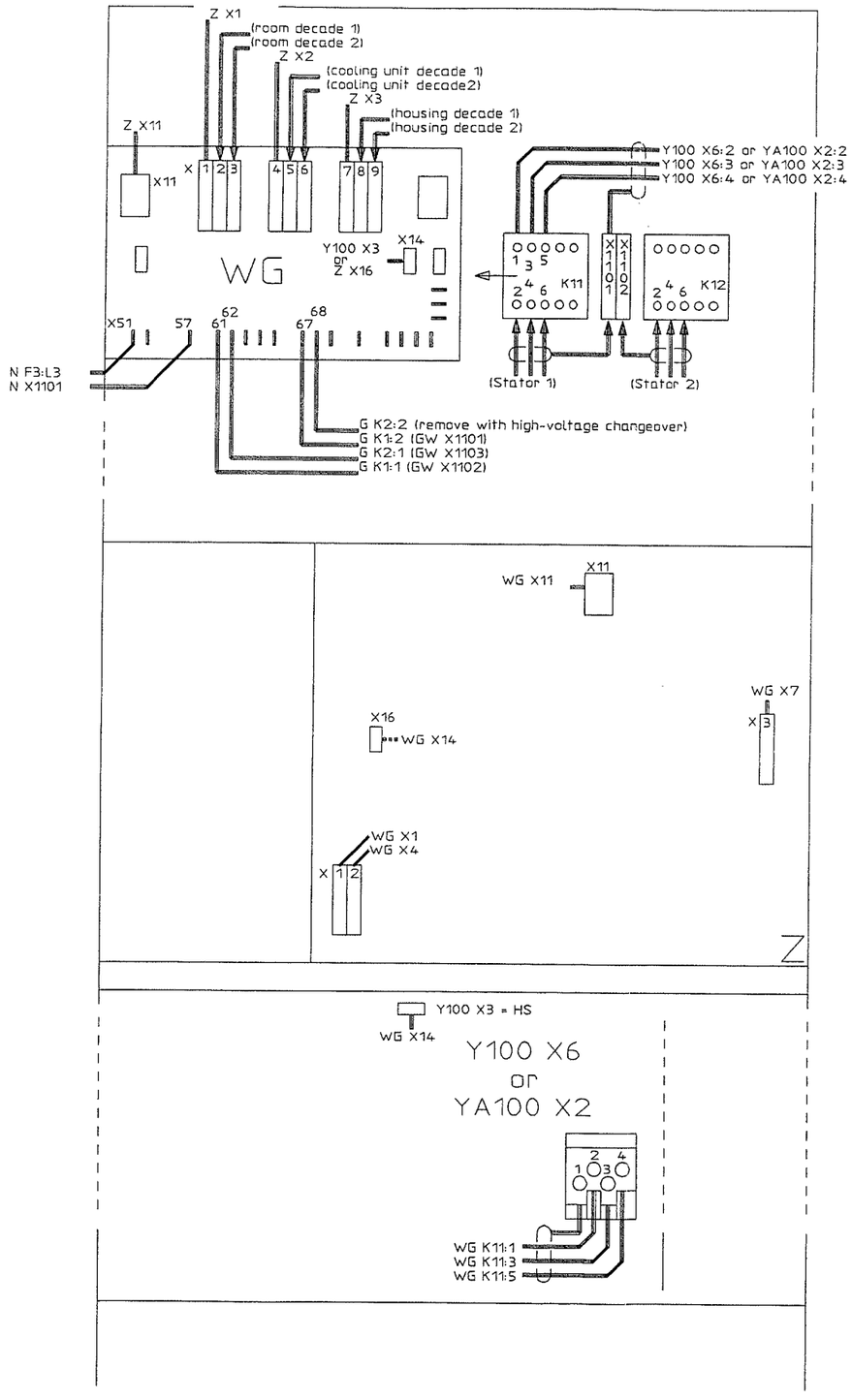
WG
Tube extension

Z2-14.1

front



rear



A3/A3 94-10-07 Ost.
v00329

OPTIMUS (94.0)
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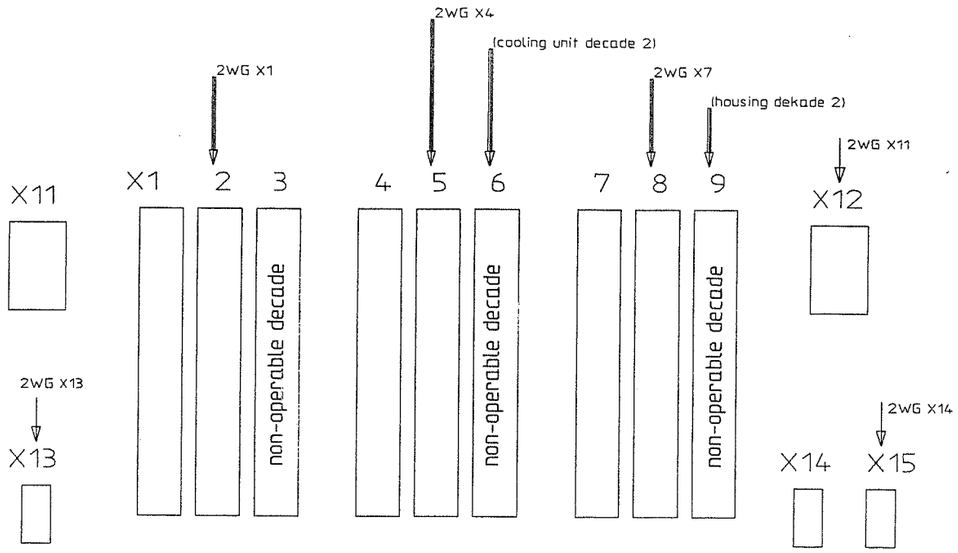
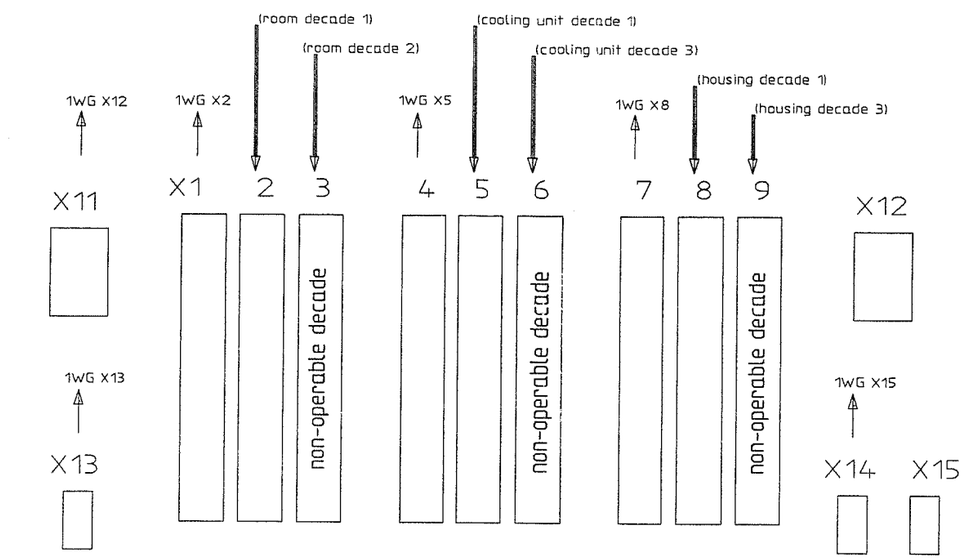
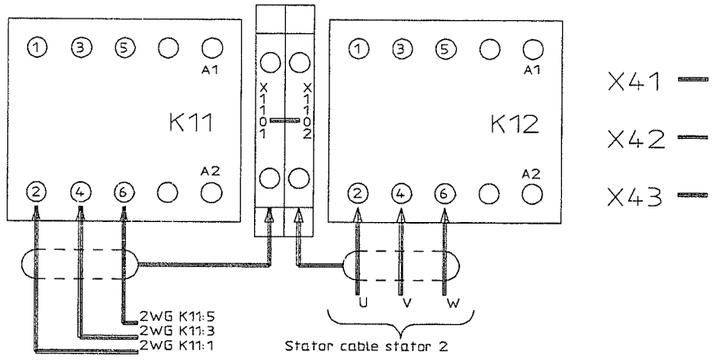
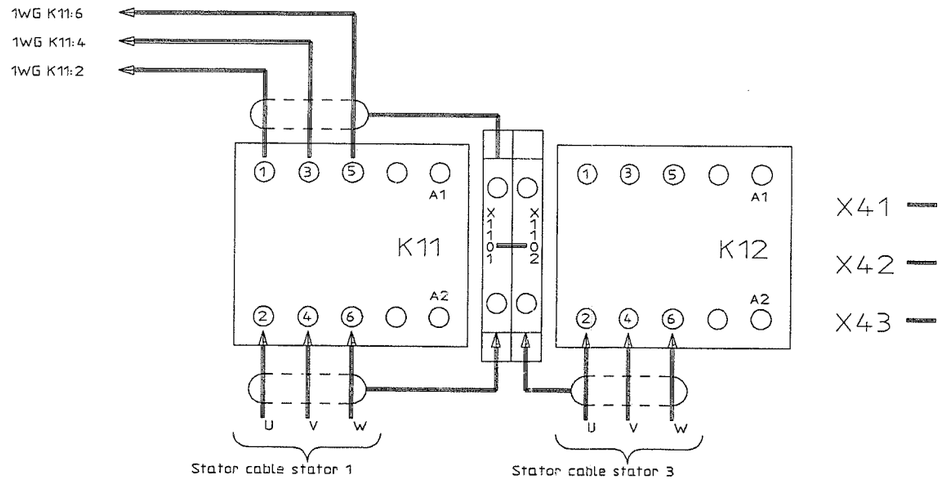
WG
Tube extension

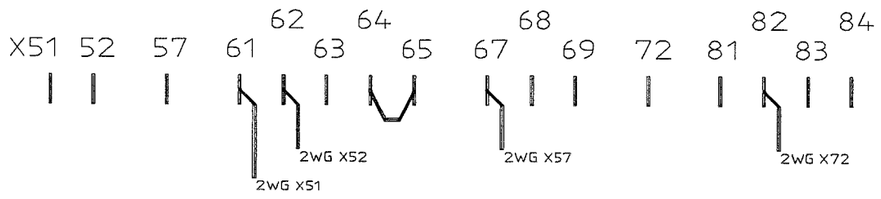
Z2-14.2

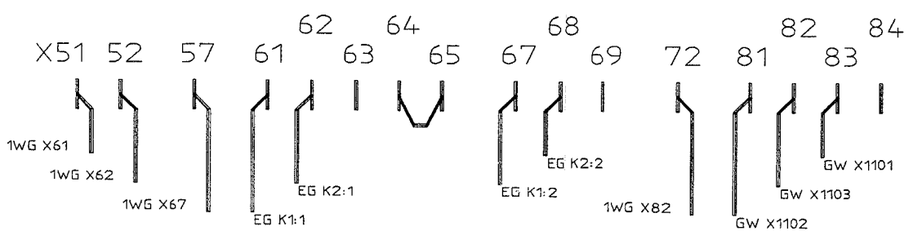












1WG | 2WG

A3/A3 94-10-07 Ost.
v00341

1WG/2WG
Tube extension

Z2-14.3

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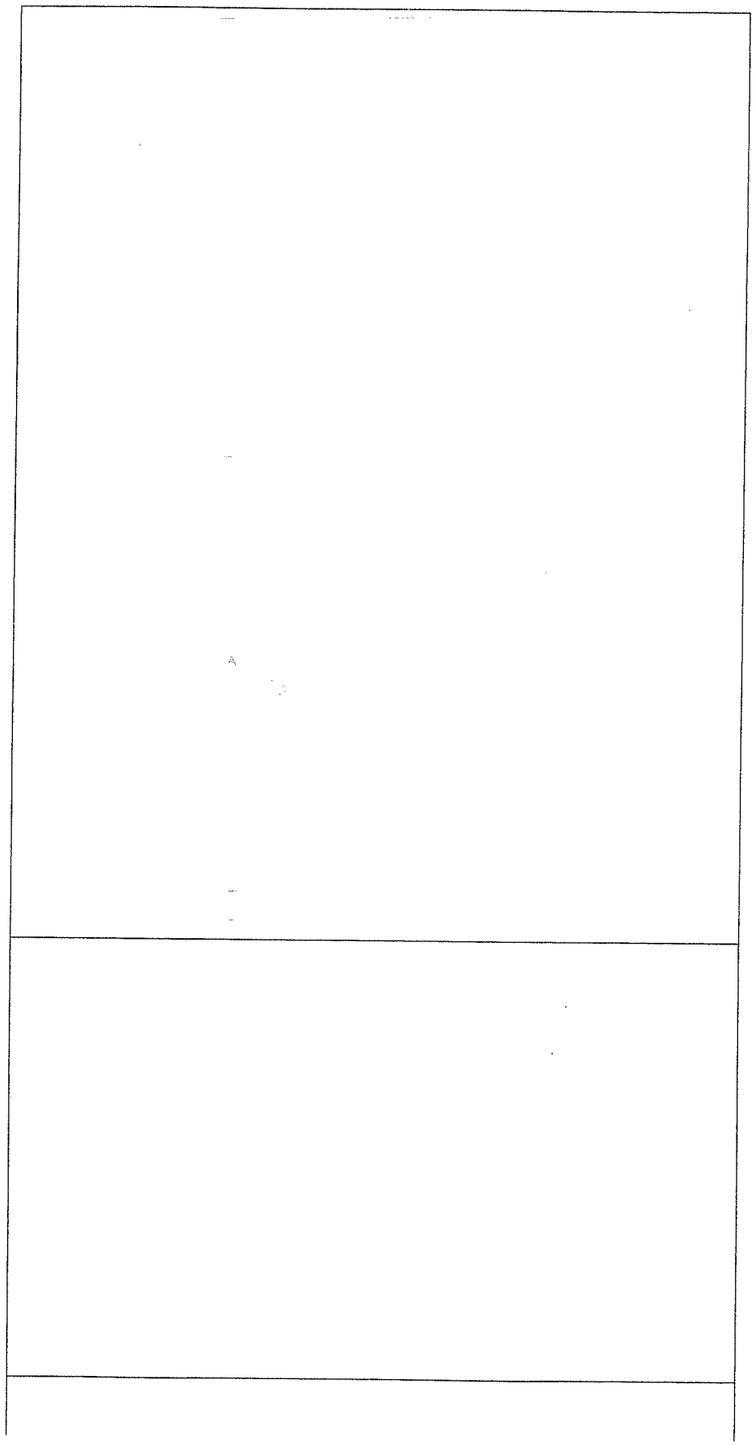
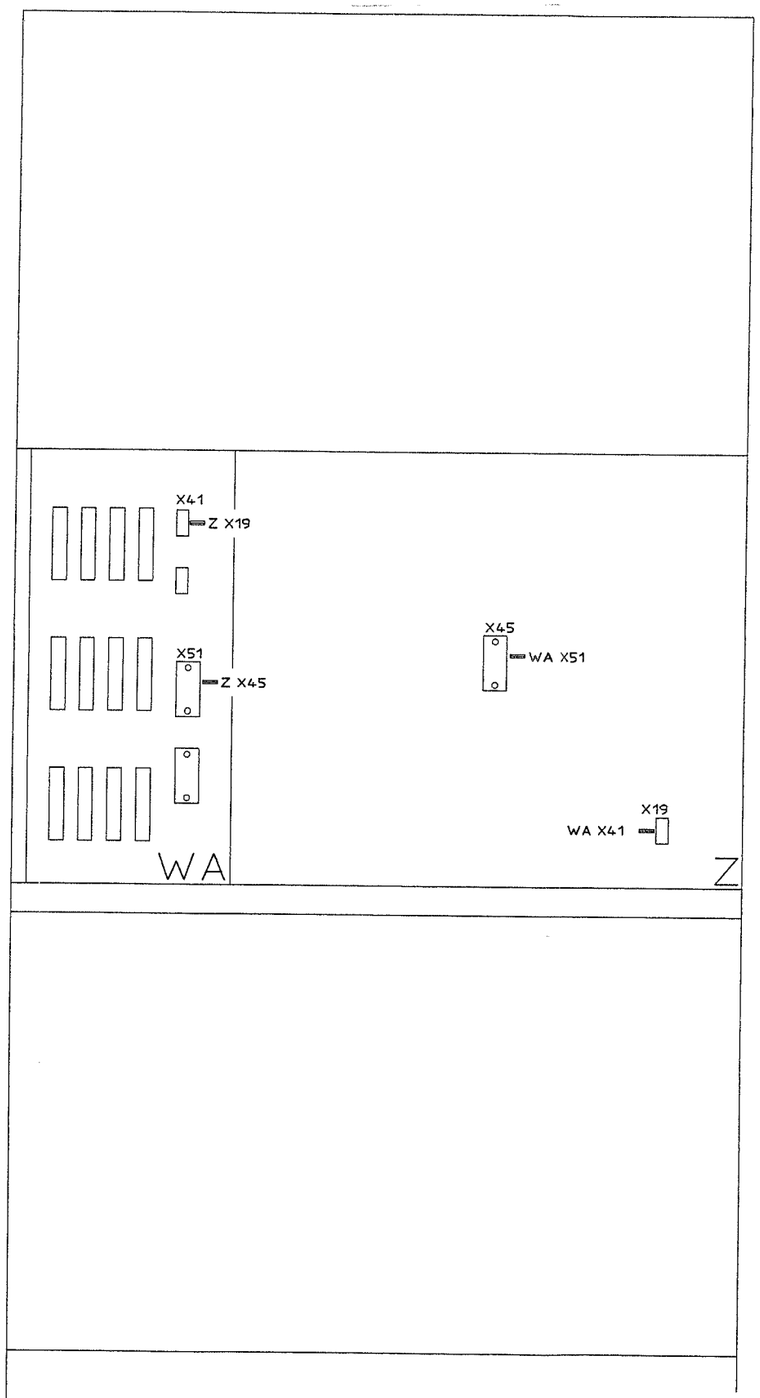
front



rear



A3/A3 94-12-14 Ost.
v00344

WA
Adapter 4 auxil. units

Z2-15.1

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